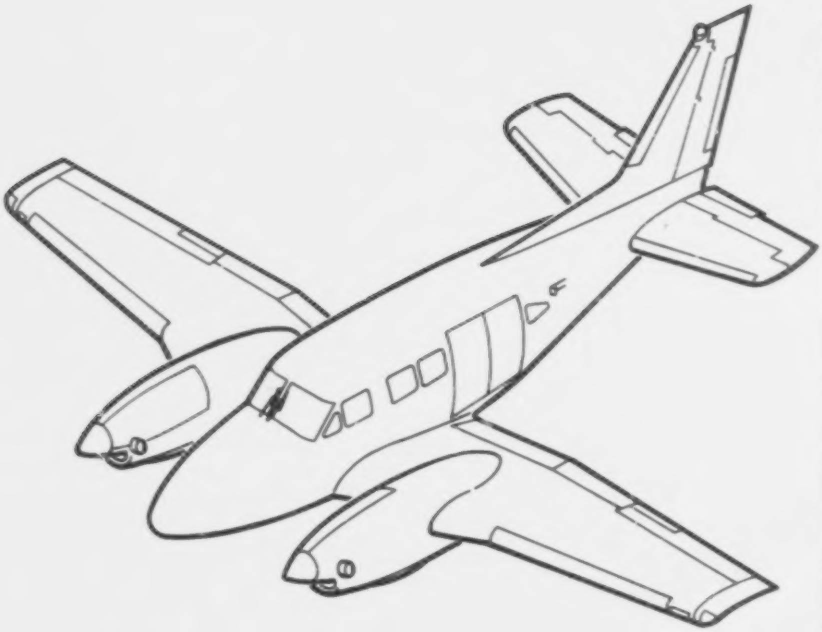
55-1510-209-10

TM 55-1510-209-10

TECHNICAL MANUAL OPERATOR'S MANUAL FOR ARMY U-21A AIRCRAFT



"Approved for public release; distribution is unlimited."

WARNING DATA

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This manual supersedes TM 55-1520-209-10, 29 October 1982, including all changes.

HEADQUARTERS DEPARTMENT OF THE ARMY

26 SEPTEMBER 1988

D 101.11:

READEX FICHE best copy available

WARNING PAGE

Personnel performing operations, procedures and practices which are included or implied in this technical manual shall observe the following warnings. Disregard of these warnings and precautionary information can cause injury or death.

STARTING AIRCRAFT

Operating procedures or practices defined in this Technical Manual must be followed correctly. Failure to do so may result in personal injury or loss of life.

Exposure to exhaust gases shall be avoided since exhaust gases are an irritant to eyes, skin and respiratory system.

NOISE LEVELS

Sound pressure levels in this aircraft during some operating conditions exceed the Surgeon General's hearing conservation criteria, as defined in TM MED 501. Hearing protection devices, such as the aviator helmet or ear plugs shall be worn by all personnel in and around the aircraft during its operation.

OPERATION OF AIRCRAFT ON GROUND

At all times during a towing operation, be sure there is a person in the cockpit to operate the brakes.

Engines will be started and operated by authorized personnel (AR 95-1).

USE OF FIRE EXTINGUISHERS IN CONFINED AREAS

Monobromotrifluoromethane (CF_3Br) is very volatile, but is not easily detected by its odor. Although non toxic, it must be considered to be about the same as other freons and carbon dioxide, causing danger to personnel primarily by reduction of oxygen available for proper breathing. During operation of the fire extinguisher, ventilate personnel areas with fresh air. The liquid shall not be allowed to come into contact with the skin, as it may cause frostbite or low temperature burns because of its very low boiling point.

VERTIGO

The strobe/beacon lights should be turned off during flight through clouds to prevent sensations of vertigo, as a result of reflections of the light on the clouds. The external rear view should also be retracted or adjusted so as to prevent any reflected light from entering the cockpit.

CARBON MONOXIDE

When smoke, suspected carbon monoxide fumes, or symptoms of lack of oxygen (hypoxia) exist, all personnel shall immediately don oxygen masks, and activate the oxygen system.

FUEL AND OIL HANDLING

Turbine fuels and lubricating oils contain additives which are poisonous and readily absorbed through the skin. Do not allow them to remain on skin longer than necessary.

SERVICING AIRCRAFT

When conditions permit, the aircraft shall be positioned so that the wind will carry fuel vapors away from all possible sources of ignition. The fueling unit shall maintain a distance of 20 feet between unit and filler point. A minimum of 10 feet shall be maintained between fueling unit and aircraft.

Prior to refueling, the hose nozzle static ground wire shall be attached to the grounding lugs that are located adjacent to filler openings.

SERVICING BATTERY

Improper service of the nickel-cadmium battery is dangerous and may result in both bodily injury and equipment damage. Wear rubber gloves, apron, and face shield when handling batteries. If potassium hydroxide is spilled on clothing, or other material wash immediately with clean water. If spilled on personnel, immediately start flushing the affected area with clean water. Continue washing until medical assistance arrives. The battery shall be serviced in accordance with TM11-6140-203-14-2 by qualified personnel only.

JET BLAST

Occasionally, during starting, excess fuel accumulation in the combustion chamber causes flames to be blown from the exhausts. This area shall be clear of personnel and flammable materials.

PROPELLER FAILURE

While operating with the PROP GOV IDLE STOP circuit breaker pulled, the secondary low pitch system is inoperative. Should the primary hydraulic low pitch stop and the primary governor fail, the propeller may reverse.

RADIOACTIVE MATERIAL

Instruments contained in this aircraft may contain radioactive material (TB 55-1500-314-25). These items present no radiation hazard to personnel unless seal has been broken due to aging or has accidentally been broken. If seal is suspected to have been broken, notify Radioactive Protective Officer.

RF BURNS

Do not stand near the antennas when they are transmitting.

TECHNICAL MANUAL

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 26 September 1988.

Operator's Manual

ARMY MODEL U-21A AIRCRAFT

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistake or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, US Army Aviation Systems Command, ATTN: AMSAV-MMD, 4300 Goodfellow Blvd., St. Louis, Missouri 63120. A reply will be furnished directly to you.

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CHAPTER 1

INTRODUCTION

1-1. General.

These instructions are for use by the operator(s). They apply to the U-21A aircraft.

1-2. Warning, Cautions, and Notes.

Warnings, cautions, and notes are used to emphasize important and critical instructions and are used for the following conditions.

WARNING

An operating procedure, practice, etc., which if not correctly followed, could result in personal injury or loss of life.

CAUTION

An operating procedure, practice, etc., which, if not strictly observed, could result in damage to or destruction of equipment.

NOTE

An operating procedure, condition, etc., which is essential to highlight.

1-3. Description.

This manual contains the best operating instructions and procedures for the U-21A under most circumstances. The observance of limitations, performance, and weight/balance data provided is mandatory except when modification is required because of multiple emergencies, adverse weather, terrain, etc. The pilot's flying experience is recognized, and therefore, basic flight principles are not included. THIS MANUAL SHALL BE CARRIED IN THE AIRCRAFT AT ALL TIMES.

1-4. Appendix A, References.

Appendix A is a listing of official publications cited within the manual applicable to and available for flight crews.

1-5. Appendix B, Abbreviations and Terms.

Appendix B is a listing of abbreviations and terms used throughout the manual.

1-6. Index.

The index lists, in alphabetical order, every titled paragraph, figure, and table contained in this manual. Chapter 7, Performance Data, has an additional index within the chapter.

1-7. Army Aviation Safety Program.

Reports necessary to comply with the safety program are prescribed in AR 385-40.

1-8. Destruction of Army Materiel to Prevent Enemy Use.

For information concerning destruction of Army materiel to prevent enemy use, refer to TM 750-244-1-5.

1-9. Phased Maintenance Checklist.

Phased Maintenance Checklist for the U-21A are prescribed in TM 55-1510-200-PM.

1-10. Forms and Records.

Army aviators flight record and aircraft maintenance records which are to be used by crew members are prescribed in TM 38-750 and TM 55-405-9.

1-11. Explanation of Change Symbols.

Changes to the test and tables, including new material on added pages shall be indicated by a vertical bar in the outer margin extending close to the entire area of the material affected. Pages with emergency markings, which consist of black diagonal lines around three edges, shall have the vertical bar or change symbol placed along the outer margins between the text and the diagonal lines. Change symbols show current changes only. A miniature pointing hand symbol is used to denote a change to an illustration. However, a vertical line in the outer margin, rather than miniature pointing hands, is utilized when there have been extensive changes made to an illustration. Change symbols are not used to indicate changes in the following:

a. Introductory material.

b. Indexes and tabular data where the change cannot be identified.

c. Blank space resulting from the deletion of text, an illustration, or a table.

d. Correction of minor inaccuracies, such as spelling, punctuation, relocation of material, etc., unless such correction changes the meaning of instructive information and procedures.

1-12. Aircraft Designation System.

The designation system prescribed by AR 70-50 is used in aircraft designations as follows:

EXAMPLE U-21A

U - Basic mission and type symbol (utility)
21 - Design number
A - Series symbol

1-13. Use of Words Shall, Will, Should and May.

Within this technical manual the word "shall" is used to indicate a mandatory requirement. The word "should" is used to indicate a nonmandatory but preferred method of accomplishment. The word "may" is used to indicate an acceptable method of accomplishment. The word "will" is used to express a declaration of purpose and may also be used where simple futurity is required.

CHAPTER 2

Aircraft and Systems Description and Operation

SECTION I. AIRCRAFT

2-1. Introduction.

The purpose of this chapter is to describe the aircraft and its systems and controls which contribute to the physical act of operating the aircraft. It does not contain descriptions of avionics and mission equipment, covered elsewhere in this manual. This chapter contains descriptive information and does not describe procedures for operation of the aircraft. These procedures are contained within appropriate chapters in the manual. This chapter also contains the emergency equipment installed. This chapter is not designed to provide instructions on the complete mechanical and electrical workings of the various systems; therefore, each is described in enough detail to make comprehension of that system sufficiently complete to allow for its safe and efficient operation.

2-2. General.

The U-21A is an unpressurized, low wing, all metal aircraft, powered by tow T74-CP-700 turboprop engines and has all-weather capability (fig. 2-1). Distinguishable features of the aircraft are the slender, streamlined engine nacelles, square-tipped wing and tail surfaces, a swept-back vertical stabilizer and a ventral fin below the empennage. Cabin entrance is made through a stair-type door on the left side of the fuselage. Special equipment in the cabin is removable. Troop seats can be folded to create unrestricted space for cargo. Pilot and copilot seats are side-by-side in the cockpit. The cockpit is separated from the cabin by a removable curtain. The pilots and passengers are afforded visibility through the safety glass windshield and plexiglass windows. A minimum crew of one pilot is required for normal aircraft operation. Accomodations within the cabin include: six passenger-controlled reading lights mounted in cold air outlet panels along the ceiling and one relief tube aft of the main entrance door. A relief tube is installed under the pilot's seat.

2-3. Dimensions.

Overall aircraft dimensions (fig. 2-3) are as follows:

Wing Span	45 ft 10.5 in
Length	35 ft 6 in
Height (at rest)	14 ft 2.56 in
Tread (between center lines of main wheels)	12 ft 9 in

2-4. Ground Turning Radius.

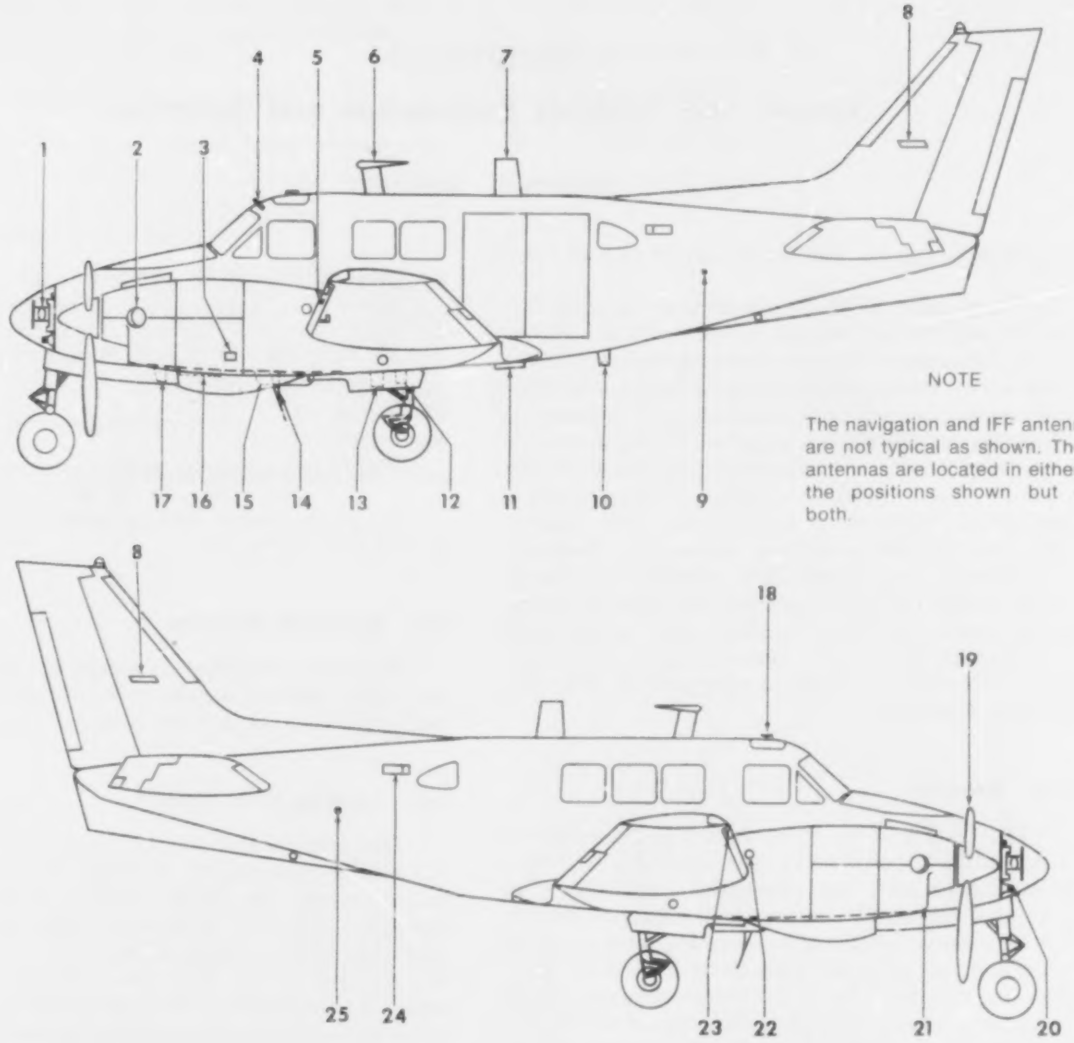
Minimum ground turning radius of the aircraft is 29 ft 8.75 in (fig.2-4).

2-5. Maximum Weights.

Maximum takeoff gross weight is 9,650 pounds. Maximum landing weight is 9,168 pounds. Maximum ramp weight is 9,705 pounds.

2-6. Landing Gear System.

The landing gear is a retractable, tricycle type, electrically operated by a single DC motor. This motor drives the main landing gear actuators through a gear box and torque tube arrangement, and also drives a chain mechanism which controls the position of the nose gear. Spring-loaded locks secure the main gear in the down position, while the jackscrew in the actuator secures the nose gear in the down position. The jackscrew in each actuator holds all three gears in the UP position, when the gear is retracted. A friction clutch between the gearbox and the torque shafts protects the motor from electrical overload in the event of a mechanical malfunction. A 50-ampere push-to-reset type circuit breaker, placarded LANDING GEAR POWER, located on the copilot's circuit breaker panel (fig. 2-7, 2-18), protects against electrical overload. Gear doors are opened and closed through a mechanical linkage connected to the landing gear. The nose wheel steering mechanism is automatically centered and the rudder pedals relieved of the steering load when the landing gear is retracted. Air-oil type shock struts, filled with compressed air and hydraulic fluid, are incorporated with the landing gear. Gear extension or retraction time should take no longer than 8 seconds.



NOTE

The navigation and IFF antennas are not typical as shown. These antennas are located in either of the positions shown but not both.

1. Radar antenna
2. Exhaust stubs
3. Accessory section exhaust vent
4. Free air temperature sensor
5. Stall warning vane
*6. Navigation antenna
7. UHF/VHF (COMM 2) antenna
*8. Navigation antenna
9. Left static air source
*10. IFF antenna
11. Radar altitude antenna
*12. IFF antenna
13. DME antenna
14. VHF (COMM 1) antenna
15. ADF antenna
16. Marker beacon antenna
17. XPDR antenna
18. Cockpit emergency entrance/exit hatch
19. Propeller
20. Glideslope antenna
21. Engine air intake
22. Ice light
23. Landing light
24. Cabin air vent outlet
25. Right static air source

*Location on some aircraft

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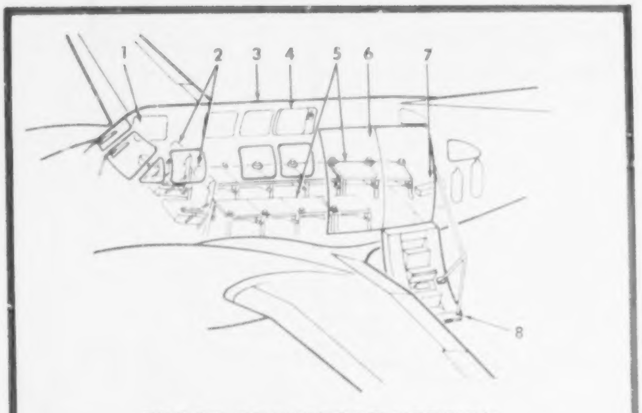
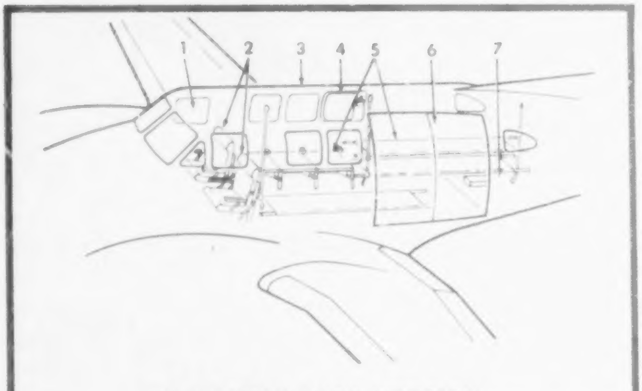
Figure 2-1. Typical General Exterior Arrangement



TROOP TRANSPORT VERSION

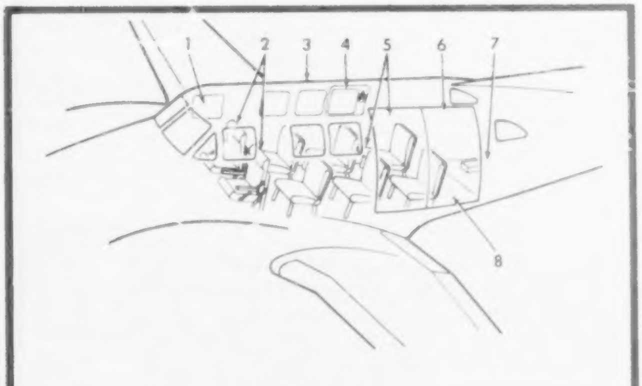
LIGHT CARGO VERSION

CONVERSION TO LIGHT CARGO VERSION CONSISTS OF REMOVING THE EXISTING AMBULANCE OR STAFF SEATING INSTALLATIONS. NO CARGO LOADING OR UNLOADING EQUIPMENT IS PROVIDED. REFER TO CHAPTER 6, AIRCRAFT LOADING FOR CARGO HANDLING INFORMATION AND INSTRUCTIONS.



AIR AMBULANCE VERSION

1. Cockpit
2. Pilot's and Copilot's Seats
3. Cabin
4. Cabin Emergency Exit Hatch
5. Passenger Seats and Stretchers
6. Cargo Door
7. Loose Tools and Accessories
8. Cabin Entrance Doors



STAFF VERSION

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Figure 2-2. General Interior Arrangement

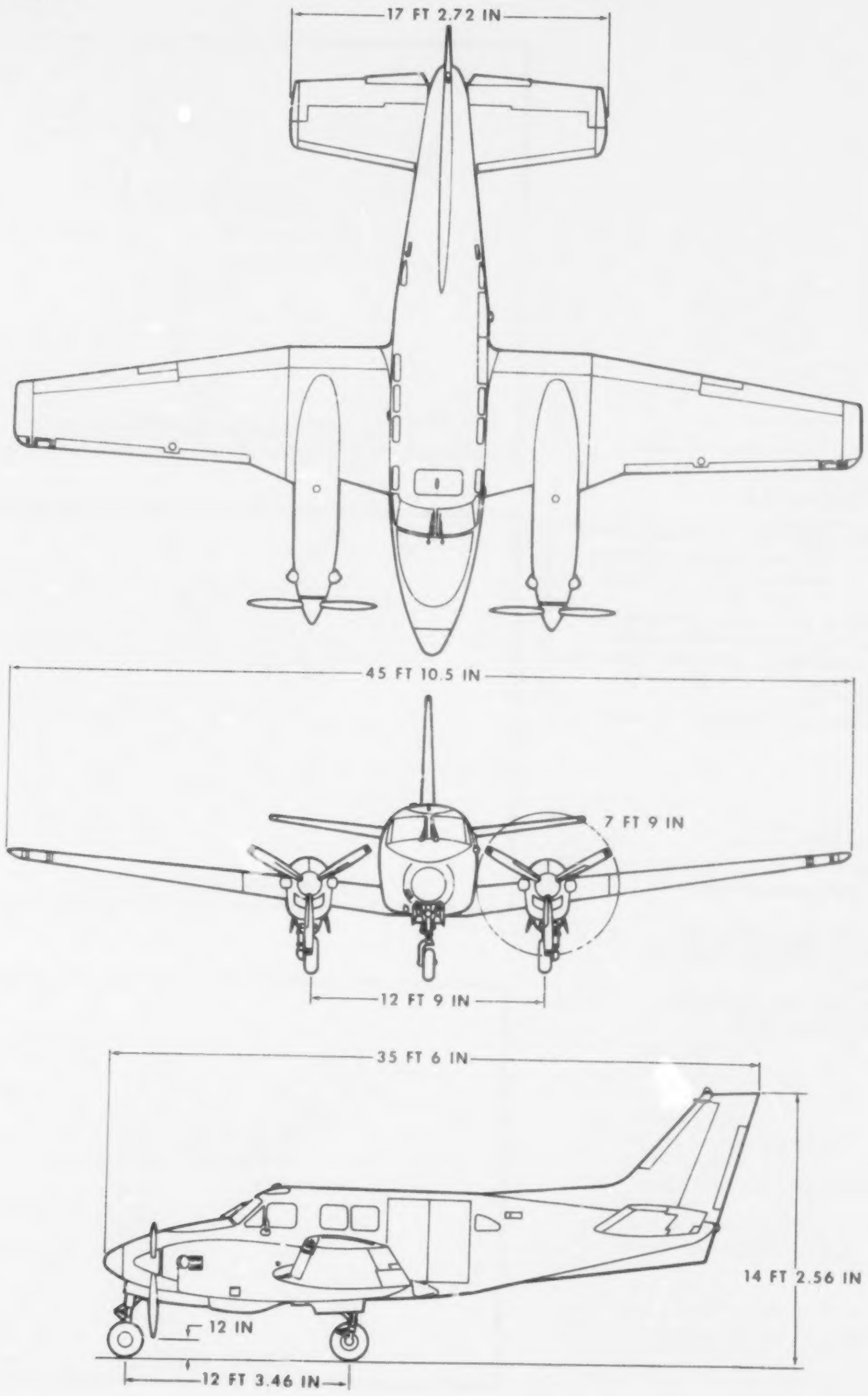
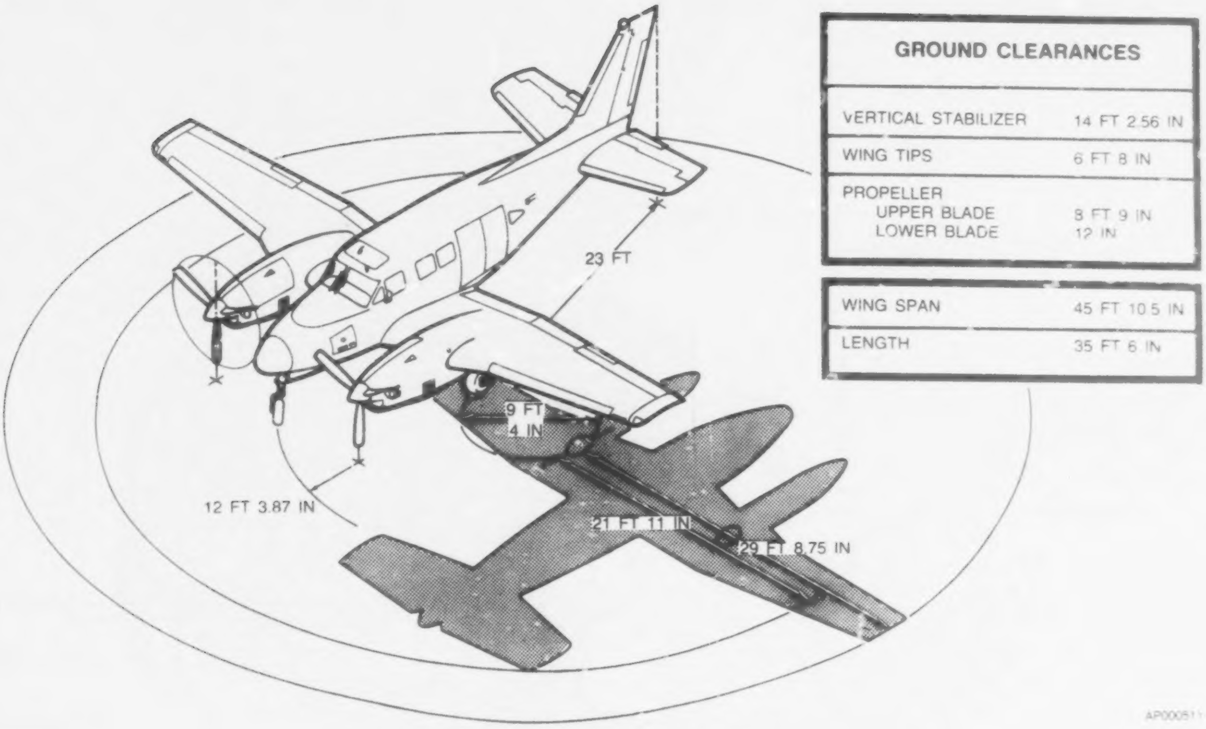

17 FT 2.72 IN
45 FT 10.5 IN
7 FT 9 IN
12 FT 9 IN
35 FT 6 IN
14 FT 2.56 IN
12 IN
12 FT 3.46 IN
AP 000510

Figure 2-3. Principal Dimensions



GROUND CLEARANCES	
VERTICAL STABILIZER	14 FT 2.56 IN
WING TIPS	6 FT 8 IN
PROPELLER	
UPPER BLADE	8 FT 9 IN
LOWER BLADE	12 IN
WING SPAN	45 FT 10.5 IN
LENGTH	35 FT 6 IN

Figure 2-4. Turning Radius and Ground Clearance

a. Landing Gear Control Switch. Landing gear system operation is controlled by a manually actuated wheel-shaped switch placarded LDG GEAR CONT, UP and DN, on the right subpanel (fig. 2-7). The control switch and associated relay circuits are protected by a 5-ampere circuit breaker, placarded LDG GR CONTROL, on the right subpanel (fig. 2-18).

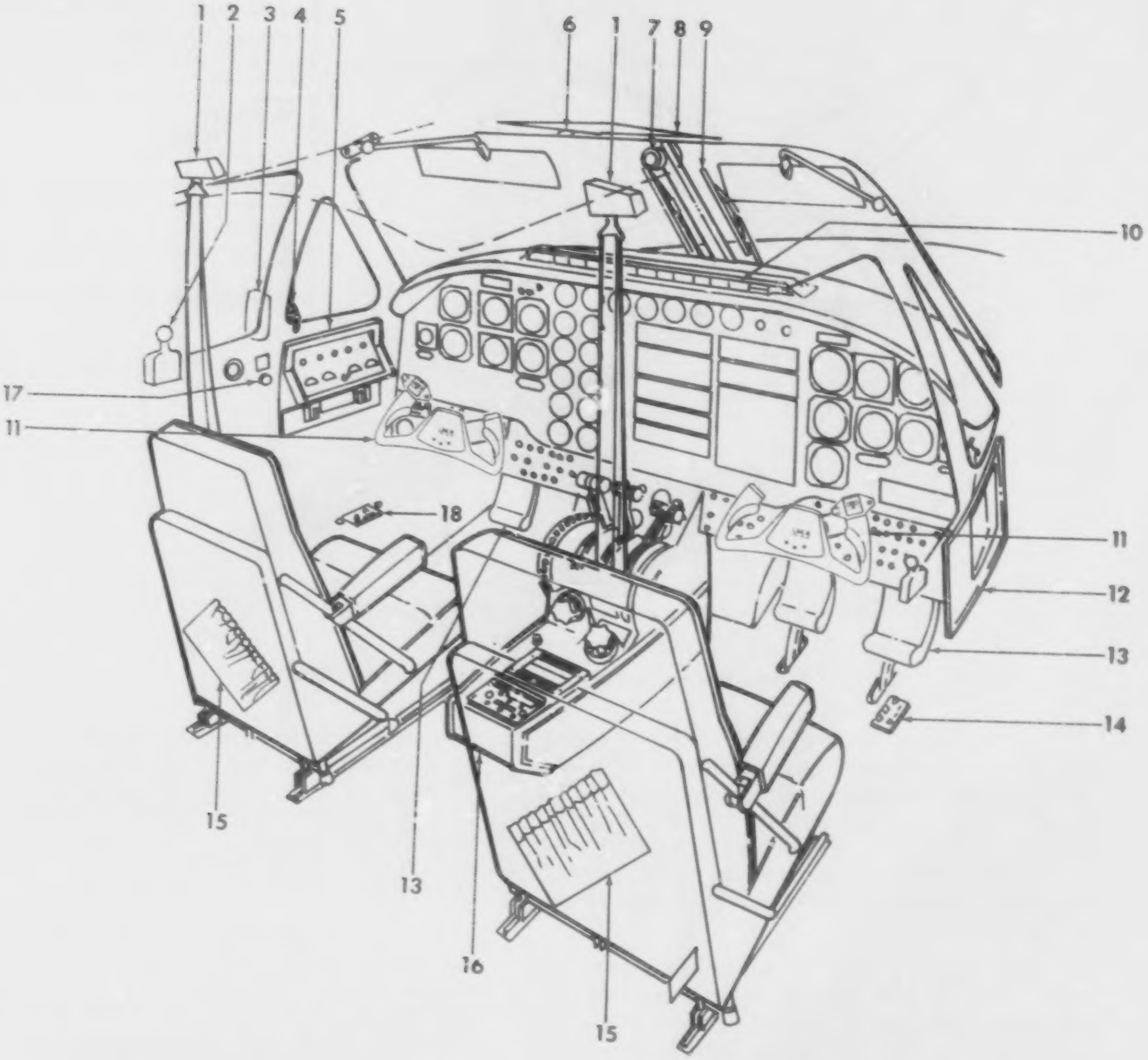
b. Landing Gear Down Position-Indicator Lights. Landing gear down position is indicated by three green lights on the control pedestal, placarded GEAR DOWN (fig. 2-6). These lights have a press-to-test feature. The circuit is protected by a 5-ampere circuit breaker, placarded LG IND, on the right subpanel.

c. Landing Gear Position Warning Lights. Two red bulbs, wired in parallel, are positioned inside the clear plastic grip on the landing gear control handle (fig. 2-6). These lights illuminate whenever the landing gear handle is in either the UP or DN position and the gear is in transit. Both bulbs will also illuminate should either or both power levers be retarded below approximately 50% of lever travel when the landing gear is not down and locked. To turn the handle lights OFF, during single-engine operation, the power lever for the inoperative engine must be advanced to a position which is higher than the setting of the warning horn microswitch. Extending the landing gear will also turn the lights off. Both red lights indicate the same warning conditions, but two are provided for a fail-safe indication in the event one bulb burns out. The circuit is protected by a 5-ampere circuit breaker, placarded LDG GR CONTROL, on the right subpanel (fig. 2-7).

d. Landing Gear Warning Light Test Button. A test button, placarded HDL LT TEST, is located on the right subpanal (fig. 2-7). Failure of the landing gear handle to illuminate red, when this test button is pressed, indicates two defective bulbs or a circuit fault. The circuit is protected by a 5-ampere circuit breaker, placarded LDG GR CONTROL, on the right subpanel (fig. 2-18).

e. Landing Gear Warning Horn. When either power lever is retarded below approximately 80% N_1 when the landing gear is not down and locked, a warning horn behind the left side of the instrument panel will sound intermittently. The warning horn circuit is protected by a 5-ampere circuit breaker, placarded LG WARN HORN, on the right subpanel (fig. 2-18).

f. Landing Gear Warning Horn Silence Button. The landing gear warning horn can be silenced during flight (with power retarded, gear and flaps up), by pressing the button, placarded WARN



1. Shoulder harness inertia reel
2. Should harness lock levers
3. Rear view mirror
4. Storm window lock
5. Fuel management panel
6. Free air temperature gage
7. Magnetic compass
8. Overhead control panel
9. Windshield wipers
10. Annunciator panel
11. Control wheels
12. Copilot's circuit breaker and fuse panel
13. Rudder pedals
14. Copilot's oxygen regulator control panel
15. Utility pockets
16. Control pedestal
17. Rear view mirror control knob
18. Pilot's oxygen regulator control panel

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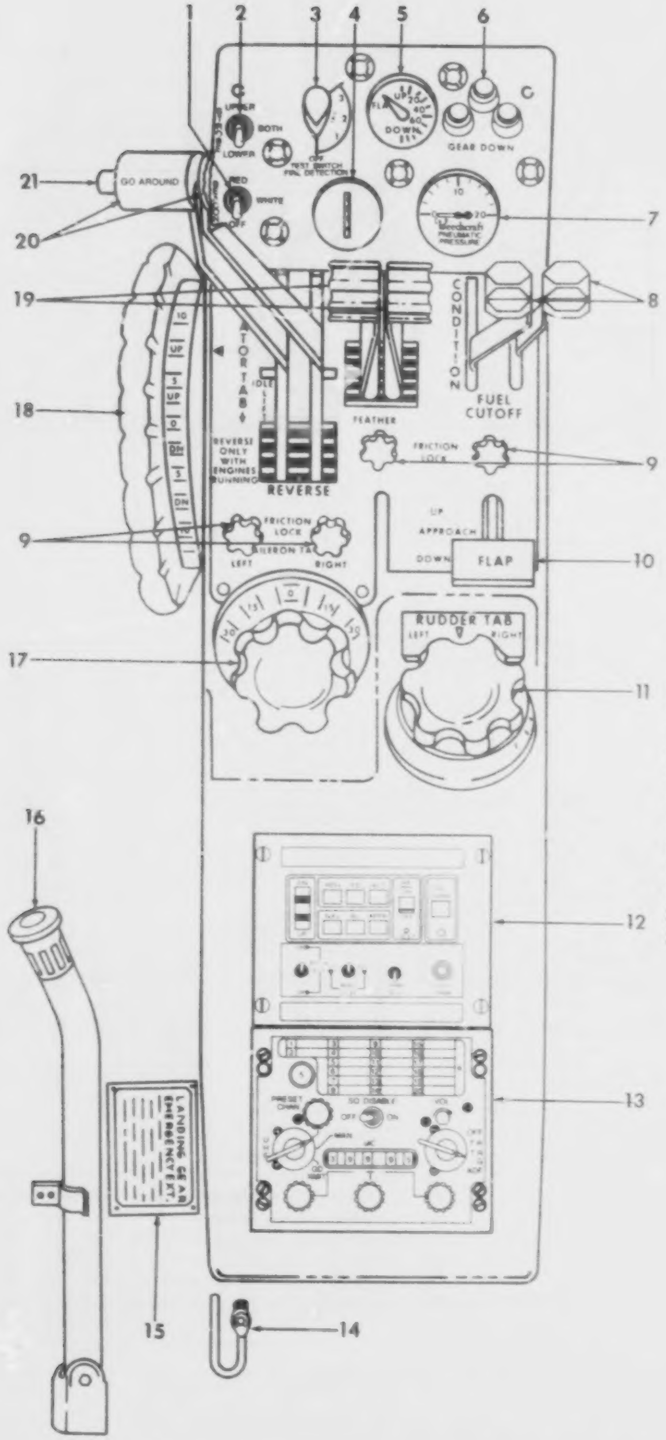
Figure 2-5. Typical Cockpit


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
GO AROUND
UPPER
BOTH
LOWER
RED
WHITE
OFF
TEST SWITCH
FIRE DETECTION
UP
DOWN
GEAR DOWN
PNEUMATIC PRESSURE
CONDITION
FUEL CUTOFF
FEATHER
FRICTION LOCK
REVERSE ONLY WITH ENGINES RUNNING
REVERSE
ELEVATOR TAB
AILERON TAB
LEFT
RIGHT
UP
APPROACH
DOWN
FLAP
RUDDER TAB
LANDING GEAR EMERGENCY EXT.

1. Strobe beacon control switch
2. Strobe beacon select switch
3. Fire detection system test switch
4. Keylock switch
5. Wing flap position indicator
6. Landing gear down position indicator lights
7. Pneumatic pressure gage
8. Condition levers
9. Friction lock knobs
10. Wing flap switch
11. Rudder tab control and position indicator
12. Flight director mode controller
13. UHF control panel
14. Landing gear emergency clutch disengage lever
15. Landing gear emergency extension placard
16. Landing gear emergency extension handle
17. Aileron tab control and position indicator
18. Elevator tab control and position indicator
19. Propeller levers
20. Power levers
21. Go-around button

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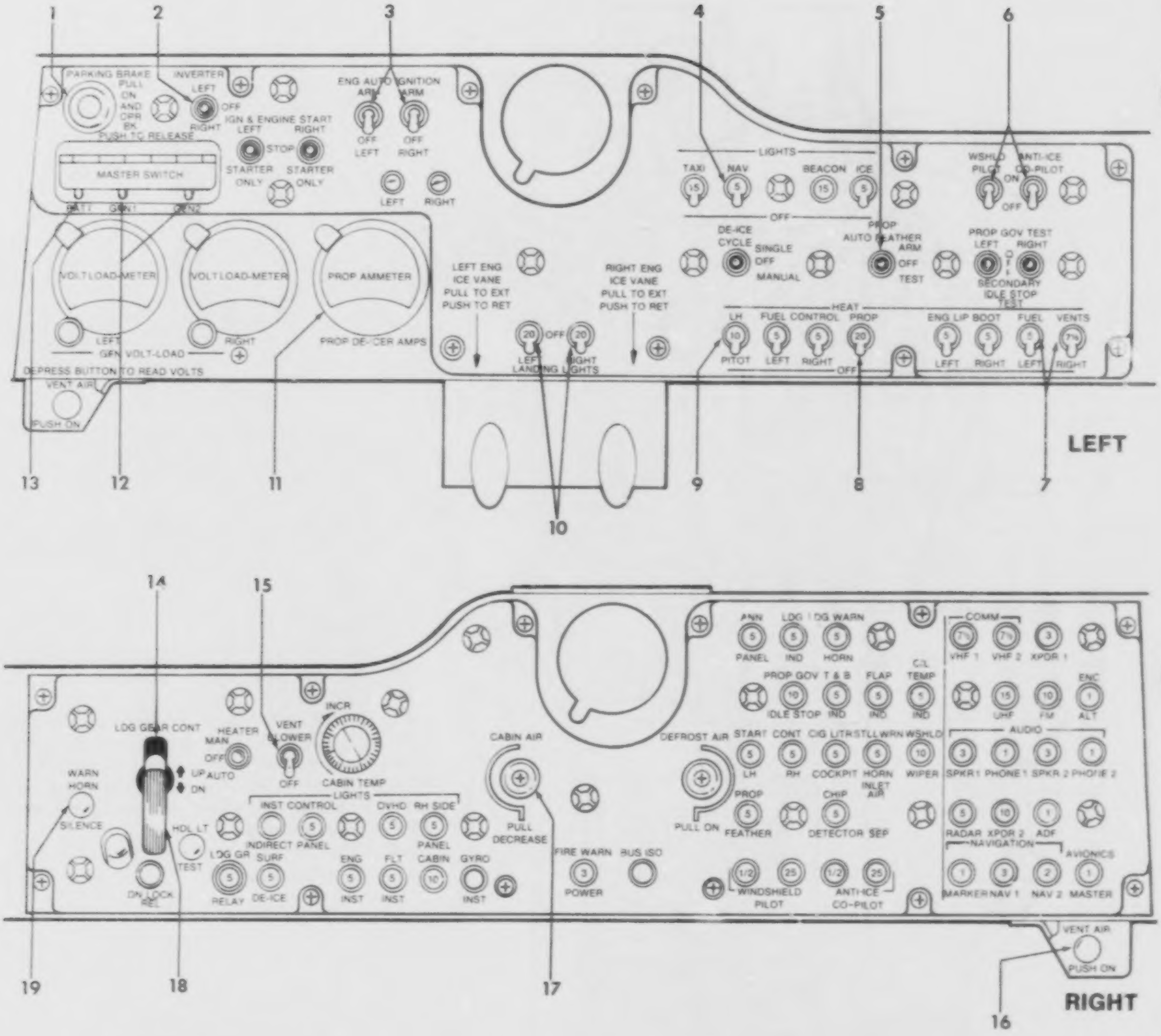
Figure 2-6. Typical Control Pedestal and Ldg Gear Emerg Extension Controls


1
2
3
4
5
6
PARKING BRAKE PULL ON AND OPR BK PUSH TO RELEASE
INVERTER LEFT OFF RIGHT
ENG AUTO IGNITION ARM OFF LEFT
ARM OFF RIGHT
IGN & ENGINE START LEFT RIGHT
STOP
STARTER ONLY
STARTER ONLY
LEFT RIGHT
MASTER SWITCH
BATT GEN1 GEN2
VOLT LOAD-METER
VOLT LOAD-METER
PROP AMMETER
LEFT
RIGHT
GEN VOLT-LOAD
PROP DE-ICER AMPS
DEPRESS BUTTON TO READ VOLTS
VENT AIR PUSH ON
LEFT ENG ICE VANE PULL TO EXT PUSH TO RET
RIGHT ENG ICE VANE PULL TO EXT PUSH TO RET
20 OFF 20
LEFT RIGHT LANDING LIGHTS
LIGHTS
TAXI NAV BEACON ICE
15 5 15 5
OFF
DE-ICE CYCLE SINGLE OFF MANUAL
PROP AUTO FEATHER ARM OFF TEST
WSHLD PILOT ON OFF
ANTI-ICE CO-PILOT
PROP GOV TEST LEFT RIGHT
SECONDARY IDLE STOP TEST
HEAT
LH 10 PITOT
FUEL CONTROL 5 LEFT 5 RIGHT
PROP 20
OFF
ENG LIP BOOT 5 LEFT 5 RIGHT
FUEL 5 LEFT
VENTS 7½ RIGHT
LEFT
13
12
11
10
9
8
7
14
15
LDG GEAR CONT
UP
DN
WARN HORN SILENCE
HEATER MAN OFF AUTO
VENT BLOWER OFF
INCR
CABIN TEMP
HDL LT TEST
ON LOCK REL
LIGHTS
INST CONTROL
INDIRECT PANEL
OVHD
RH SIDE PANEL
LDG GR RELAY
SURF DE-ICE
ENG INST
FLT INST
CABIN
GYRO INST
CABIN AIR PULL DECREASE
FIRE WARN 3 POWER
BUS ISO
DEFROST AIR PULL ON
ANN 5 PANEL
LDG 5 IND
LDG WARN 5 HORN
PROP GOV 10 IDLE STOP
T & B 5 IND
FLAP 5 IND
C/L TEMP 5 IND
START LH
CONT RH
CIG LTR COCKPIT
STLL WRN HORN INLET AIR
WSHLD 10 WIPER
PROP 5 FEATHER
CHIP 5 DETECTOR SEP
1/2 25 WINDSHIELD PILOT
1/2 25 ANTI-ICE CO-PILOT
COMM
7½ VHF 1
7½ VHF 2
3 XPDR 1
15 UHF
10 FM
ENC 1 ALT
AUDIO
3 SPKR 1
1 PHONE 1
3 SPKR 2
1 PHONE 2
5 RADAR
10 XPDR 2
1 ADF
NAVIGATION
1 MARKER
3 NAV 1
2 NAV 2
AVIONICS 1 MASTER
VENT AIR PUSH ON
19
18
17
16
RIGHT

1. Parking brake handle
2. Inverter switch
3. Engine autoignition switches
4. Navigation lights switch
5. Propeller autofeather switch
6. Windshield anti-ice switches
7. Fuel vent heat switches
8. Propeller heat switch
9. Pitot heat switch
10. Landing light switches
11. Propeller ammeter
12. Generator switches
13. Battery switch
14. Landing gear in transit warning lights (in handle)
15. Ventilation blower switch
16. Copilot's air inlet control
17. Cabin air control
18. Landing gear control switch
19. Landing gear warning horn silence button

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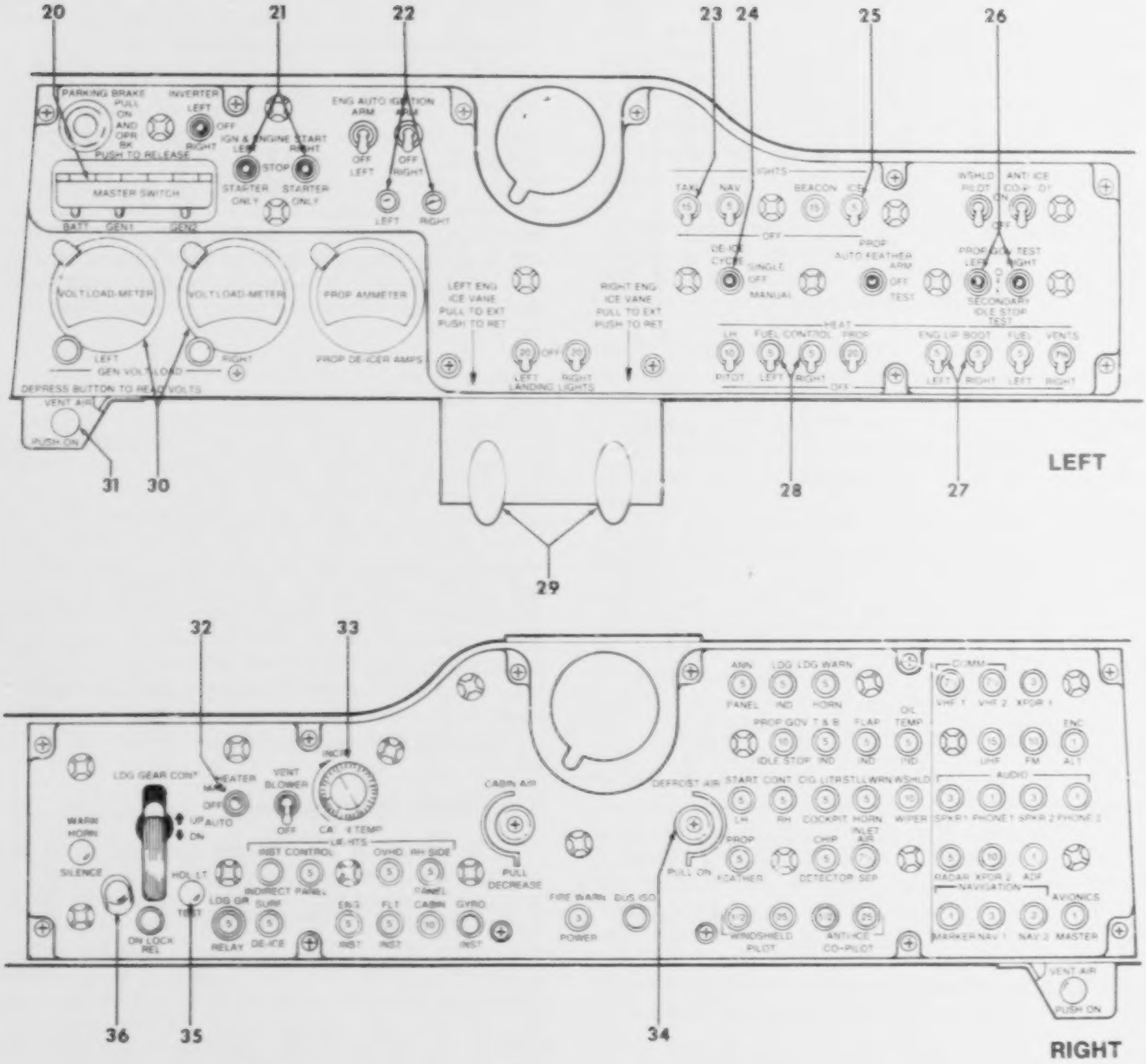
Figure 2-7. Typical Subpanels (sheet 1 of 2)


20
21
22
23
24
25
26
PARKING BRAKE PULL ON AND OPR BK PUSH TO RELEASE
INVERTER LEFT OFF RIGHT
IGN & ENGINE START LEFT STOP RIGHT
STARTER ONLY
STARTER ONLY
ENG AUTO IGNITION ARM
OFF LEFT
OFF RIGHT
LEFT
RIGHT
MASTER SWITCH
BATT
GEN1
GEN2
VOLT LOAD-METER
VOLT LOAD-METER
PROP AMMETER
LEFT
RIGHT
GEN VOLT LOAD
DEPRESS BUTTON TO READ VOLTS
PROP DE-ICER AMPS
VENT AIR
PUSH ON
LEFT ENG ICE VANE PULL TO EXT PUSH TO RET
RIGHT ENG ICE VANE PULL TO EXT PUSH TO RET
LEFT
RIGHT
LANDING LIGHTS
OFF
LIGHTS
TAXI
NAV
BEACON
ICE
OFF
DE-ICE CYCLE
SINGLE
OFF
MANUAL
PROP AUTO FEATHER
ARM
OFF
TEST
WSHLD PILOT
ANTI ICE CO-PILOT
ON
OFF
PROP GOV TEST
LEFT
RIGHT
SECONDARY IDLE STOP TEST
HEAT
LH
PITOT
FUEL CONTROL
LEFT
RIGHT
PROP
ENG LIP BOOT
LEFT
RIGHT
FUEL
LEFT
VENTS
RIGHT
OFF
31
30
28
27
LEFT
29
32
33
LDG GEAR CONT
UP
DN
WARN HORN
SILENCE
HEATER
MAN
OFF
AUTO
VENT BLOWER
OFF
INCR
CABIN TEMP
CABIN AIR
PULL DECREASE
DEFROST AIR
PULL ON
LIGHTS
INST CONTROL
OVHD
RH SIDE PANEL
INDIRECT PANEL
HDL LT TEST
ON LOCK REL
LDG GR RELAY
SURF DE-ICE
ENG INST
FLT INST
CABIN
GYRO INST
FIRE WARN POWER
BUS ISO
ANN PANEL
LDG IND
LDG WARN HORN
PROP GOV IDLE STOP
T & B IND
FLAP IND
OIL TEMP IND
START CONT LH
RH
CIG LTR COCKPIT
STLL WRN HORN
WSHLD WIPER
PROP FEATHER
CHIP DETECTOR
INLET AIR SEP
WINDSHIELD PILOT
ANTI-ICE CO-PILOT
COMM
VHF 1
VHF 2
XPDR 1
UHF
FM
ENC ALT
AUDIO
SPKR 1
PHONE 1
SPKR 2
PHONE 2
RADAR
XPDR 2
ADF
NAVIGATION
MARKER
NAV 1
NAV 2
AVIONICS MASTER
VENT AIR
PUSH ON
36
35
34
RIGHT

20. Master switch gang bar
21. Ignition and engine start/starter only switches
22. Autoignition arm lights
23. Taxi light switch
24. Deice cycle switch
25. Ice lights switch
26. Propeller governor test and secondary idle stop test switches
27. Engine lip boot heat switches
28. Fuel control heat switches
29. Engine ice vane control handles
30. Volt-loadmeters
31. Pilot's air inlet control
32. Heater control switch
33. Heater temperature control rheostat
34. Defrost air control
35. Landing gear handle lights test switch
36. Landing gear handle downlock release

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Figure 2-7. Typical Subpanels (sheet 2 of 2)

HORN SILENCE, on the right subpanel (fig. 2-7). After silencing the warning horn, it will remain silent until either the flaps are extended or the power levers are advanced, then retarded again. During single-engine operation, the warning horn may be silence button (flaps up) or advancing the power lever for the inoperative engine to a position above the warning horn microswitch setting. If the warning horn as been silenced by pressing the silence button, the power lever for the inoperative engine must again be advanced past the warning horn microswitch setting to reset the switch. The horn will sound however, if the power lever for the operative engine is retarded. The circuit is protected by a 5-ampere circuit breaker, placarded LG WARN HORN, on the right subpanel (fig. 2-7).

g. Landing Gear Safety Switches. A safety switch on each main landing gear shock strut controls the operation of various aircraft systems that function only during flight or only during ground operation. These switches are mechanically actuated whenever the main landing gear shock struts are extended (normally after takeoff), or compressed (normally after landing). The safety switch on the right main landing gear strut deactivates the landing gear control circuits when the strut is compressed. This switch also activates a down-lock hook, preventing the landing gear handle from being raised while the aircraft is on the ground. The hook, which unlocks automatically after takeoff, can be manually over-ridden by pressing down on the red button, placarded DN LCK REL located adjacent to the landing gear handle (fig. 2-7). If the over-ride is used and the landing gear control switch is raised, power will be supplied to the warning horn circuit and the horn will sound. When the left main landing gear strut is compressed the left safety switch establishes circuit continuity so that controls may operate the combustion blower and the ventilation blower (for nose avionics and cockpit/cabin areas). When the left strut is extended, the ventilation blower may not be operated; however, combustion blower circuits are reconnected in flight by the flight operation relay.

CAUTION

Do not pump handle after GEAR DOWN position indicator lights (3) are illuminated. Further movement of the handle could damage the drive mechanism.

h. Landing Gear Emergency Clutch Disengage Lever. Prior to emergency or manual landing gear extension, the landing gear motor must be disengaged from the landing gear drive mechanism. This is accomplished by a manually-operated clutch disengage lever (fig. 2-6) located adjacent to the landing gear emergency extension handle. To disengage the clutch, pull the clutch lever up and turn clockwise. To engage the clutch, turn the clutch lever counter-clockwise and release.

i. Landing Gear Emergency Extension Handle. The landing gear emergency extension handle (fig. 2-6) located on the cockpit floor to the right of the pilot's seat, is used for manual extension of the landing gear. The landing gear extension system is actuated by pumping the handle up and down. This movement operates a ratchet mechanism which drives the normal system to extend the landing gear. The landing gear cannot be retracted manually. Refer to chapter 9 for emergency gear extension procedures.

2-7. Steerable Nose Wheel.

The aircraft can be maneuvered on the ground by the steerable nose wheel system. Direct linkage from the rudder pedals to the nose wheel steering linkage allows the nose wheel to be turned 12° to the left of center or 14° to the right. When rudder pedal steering is augmented by the main wheel braking action, the nose wheel can be deflected up to 48° either side of center. Shock loads which would normally be transmitted to the rudder pedals are absorbed by a spring mechanism in the steering linkage. Retraction of the landing gear automatically centers the nose wheel and disengages the steering linkage from the rudder pedals.

2-8. Wheel Brake System.

The main landing wheels are equipped with multiple-disc hydraulic brakes actuated by master cylinders attached to the rudder pedals at the pilot's and copilot's position. A shuttle valve, adjacent to each set of pedals, permits braking action changeover from one set of pedals to the other. Brake fluid is supplied to the system from the reservoir in the nose compartment. The toe brake sections of the rudder pedals are connected to the master cylinders which actuate the system for the corresponding wheels. No emergency brake system is provided. Repeated and excessive application of brakes, without allowing sufficient time for cooling, will cause loss of brake efficiency, possible failure of brake or wheel structure, possible blowout of tires, and in extreme cases may cause the wheel and brake assembly to be destroyed by fire. Parking brakes shall not be set during flight. The following precautions should be observed insofar as is practical:

a. Extreme care should be used during any braking application to prevent skidding the tires and causing flat spots.

b. With the landing gear extended, approximately 10 minutes should be allowed to elapse between landings where maximum braking has been applied.

c. With the landing gear retracted, approximately 30 minutes should be allowed to elapse between maximum-brake application landings.

CAUTION

It is damaging to the braking system if continuous braking drag is applied over an appreciable distance while taxiing at slow speeds.

d. For short landing rolls, reversing the propellers and a single, smooth application of the brakes with constantly increasing pedal pressure is most desirable.

2-9. Parking Brake Handle.

Dual parking brake valves are installed adjacent to the rudder pedals between the master cylinders of the pilot's rudder pedals and the wheel brakes. Both valves can be closed simultaneously by pulling out the handle placarded PARKING BRAKE on the left subpanel (fig. 2-7), then pressing the brake pedals on the pilot's side to build up pressure. Parking brakes are released when the brake handle is pushed in.

2-10. Entrance and Exit Provisions.

WARNING

Do not open door or attempt to lock or secure during flight.

CAUTION

Structural Structural damage may be caused if more than one person is on the entrance door at any time.

The main cabin entrance door is used for normal or emergency exit (fig. 2-8). A removable window (cabin emergency exit hatch) on the right side of the fuselage, and the cockpit emergency entrance/exit hatch are used for emergency exit only. The main cabin entrance door, the cabin emergency exit hatch (removable window), and the cockpit emergency entrance/exit hatch provide emergency escape routes from the aircraft either on the ground or when ditching. Refer to chapter 9 for emergency exit locations and bailout procedures.

a. Aircraft entrance door provisions consist of two adjoining door assemblies on the left side of the fuselage which open outward from the cabin compartment. The forward, or cargo door is normally closed during egress of the crew. The cargo door is secured in a closed position by two hand-operated, locking slide-bolts, located on the top and bottom aft corners of the door. The door opens forward on two hinges and is held open by a swivel rod, which inserts into a hold-fitting installed in the wing fairing below the door opening. A cable attaches to the door top and to inside fuselage structure above the door opening, preventing damage due to door overswing. The aft side of the cargo door is part of the frame structure for the main entrance door, and has striker plates for securing the door in the closed position. The main entrance door must be open before the cargo door can be opened.

b. Normal aircraft entry and exit is accomplished through the main entrance door. This door may be opened, or closed from either the inside of outside of the aircraft by clockwise/counterclockwise rotation of the door handles. The stair-type steps are integrally mounted on the inside of the door. A plastic encased cable provides a stop to support the door in the open position, services a stop to support the door in the open position, serves as a hand assist during entry or exit, and as a convenience for closing the door from the inside.

2-11. Cabin Door Warning Light.

WARNING

Do not open door or attempt to lock or secure it during flight.

As a safety precaution, an advisory light placarded CABIN DOOR OPEN on the annunciator panel (fig. 2-22) indicates the main entrance door is not closed and locked. This circuit is protected by a 5-ampere circuit breaker, placarded ANN PANEL, located on the right subpanel (fig. 2-7).

2-12. Windows.

Forward visibility from the cockpit is provided by a two piece electro-thermal windshield made of laminated plate glass. Side visibility for the pilot and copilot is provided by a window made of acrylic on

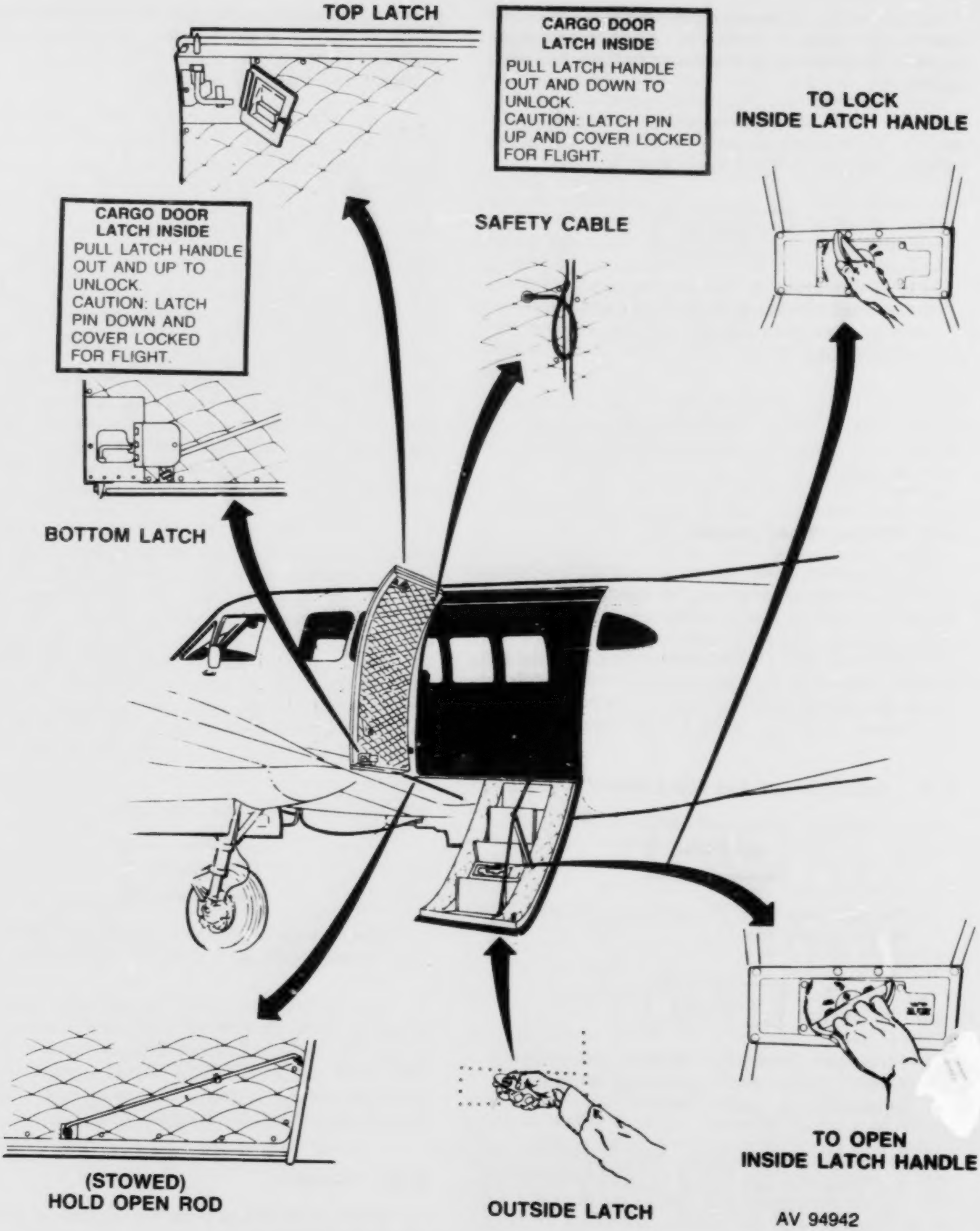

TOP LATCH
CARGO DOOR LATCH INSIDE
PULL LATCH HANDLE OUT AND DOWN TO UNLOCK.
CAUTION: LATCH PIN UP AND COVER LOCKED FOR FLIGHT.
TO LOCK INSIDE LATCH HANDLE
CARGO DOOR LATCH INSIDE
PULL LATCH HANDLE OUT AND UP TO UNLOCK.
CAUTION: LATCH PIN DOWN AND COVER LOCKED FOR FLIGHT.
SAFETY CABLE
BOTTOM LATCH
TO OPEN INSIDE LATCH HANDLE
(STOWED) HOLD OPEN ROD
OUTSIDE LATCH
AV 94942

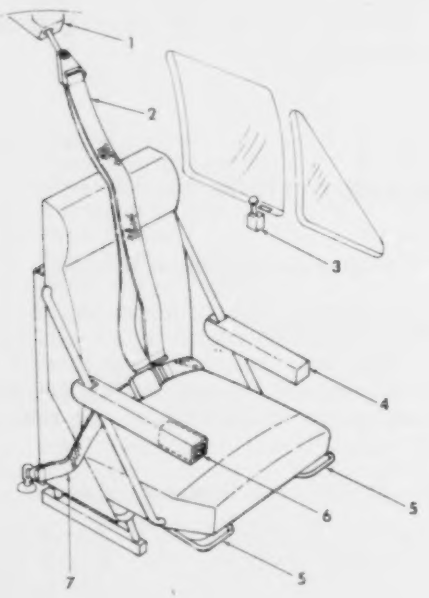
Figure 2-8. Main Entrance and Cargo Door

each side of the cockpit. Immediately forward of each side window is a triangular-shaped storm window which may be opened during flight or ground operation. Windows are provided on each side of the cabin.

2-13. Seats.

a. Pilot and Copilot Seats. Aircraft seating accommodations for the pilot and copilot are adjustable, chair-type units (fig. 2-9). An entry aisle separated the two seats. Both seats can be adjusted for and aft, vertically. The fore and aft adjustment handle is located beneath the bottom front inboard corner of each seat. Pulling up on the handle allows the seat to move fore and aft. The vertical adjustment handle is located beneath the bottom front outboard corner of each seat. Pulling up on the handle, allows the seat to move up or down.

b. Seat Belts and Shoulder Harnesses - Pilot and Copilot Seats. Pilot and copilot seats are each equipped with a seat belt and shoulder harness. Each belt attaches to two floor disconnect fittings located aft of the seat. Pilot and copilot shoulder harnesses incorporate an inertia reel to provide crash restraint. The inertia reel will lock automatically under a 2 "G" impact, or may be manually locked if desired.



NOTE

ONLY PILOT'S SEAT IS SHOWN. COPILOT'S SEAT IS IDENTICAL

1. Inertia reel
2. Shoulder harness
3. Inertia reel lock
4. Armrest
5. Seat adjustment handle
6. Ash tray
7. Seat belt

Figure 2-9. Pilot's and Copilot's Seats

SECTION II. EMERGENCY EQUIPMENT

2-14. Description.

The equipment covered in this section includes all emergency equipment, except that which forms part of a complete system. For example, landing gear system, etc. For the operation of emergency exits and for location of all emergency equipment, refer to chapter 9.

2-15. Hand-Operated Fire Extinguisher.

WARNING

Exposure to high concentrations of monobromotrifluoromethane (CF_3Br) or decomposition products should be avoided. The liquid should not be allowed to come into contact with the skin, as it may cause frost bite or low temperature burns because of its very low boiling point.

One hand-operated fire extinguisher is mounted below the copilot's seat, and a second is located aft of the main entrance door (fig. 9-1). This is of the Monobromotrifluoromethane (CF_3Br) type. The extinguisher is charged to a pressure of 150 to 170 PSI, and emits a forceful stream. Use an extinguisher with care within the limited area of the cabin to avoid severe splashing.

NOTE

Engine fire extinguisher systems are not installed.

2-16. First Aid Kits.

Five first aid kits are provided in the aircraft (fig. 9-1). One kit is installed on the backside of the pilot and copilot seat respectively. Three kits are located at the back of the cabin compartment.

2-17. Fire Axe.

The fire axe is located under the copilot's seat in the cockpit.

SECTION III. ENGINES AND RELATED SYSTEMS

2-18. Description.

The aircraft is powered by two T74-CP-700 turboprop engines rated at 550 SHP (fig. 2-10). This engine is a reverse flow, free turbine type, employing a three-stage axial and a single-stage centrifugal compressor assembled as an integral unit. A large area circular steel screen around the air intake at the rear of the gas generator case precludes foreign object ingestion by the compressor. The combustion chamber is of the reverse flow type and consists primarily of an annular heat-resistant steel liner open at one end. The single-stage compressor turbine and free power turbine are in line with each other and are counter-rotating. The single-stage power turbine is connected through a two-stage planetary reduction gearbox to a flanged propeller shaft. For the purpose of engine RPM/power ratio familiarization and computation, compressor turbine rotational speed (RPM) will be referred to as N_1, and the propeller speed N_2 as actual indicated tachometer RPM. The accessory drive at the aft end of the engine provides power to drive the fuel pumps, fuel control, the oil pumps, the starter/generator, and the tachometer transmitter. The reduction gear box forward of the power turbine provides gearing for the propeller tachometer transmitter, the propeller overspeed governor, and the propeller governor. The oil tank, filler cap and dip stick are an integral part of the compressor air inlet and the accessory section.

2-19. Engine Compartment Cooling.

The forward engine compartment including the accessory section is cooled by air entering around the exhaust stub cutouts, the gap between the propeller spinner and forward cowling, and exhausting through louvers located behind the exhaust stubs.

2-20. Air Induction Systems - General.

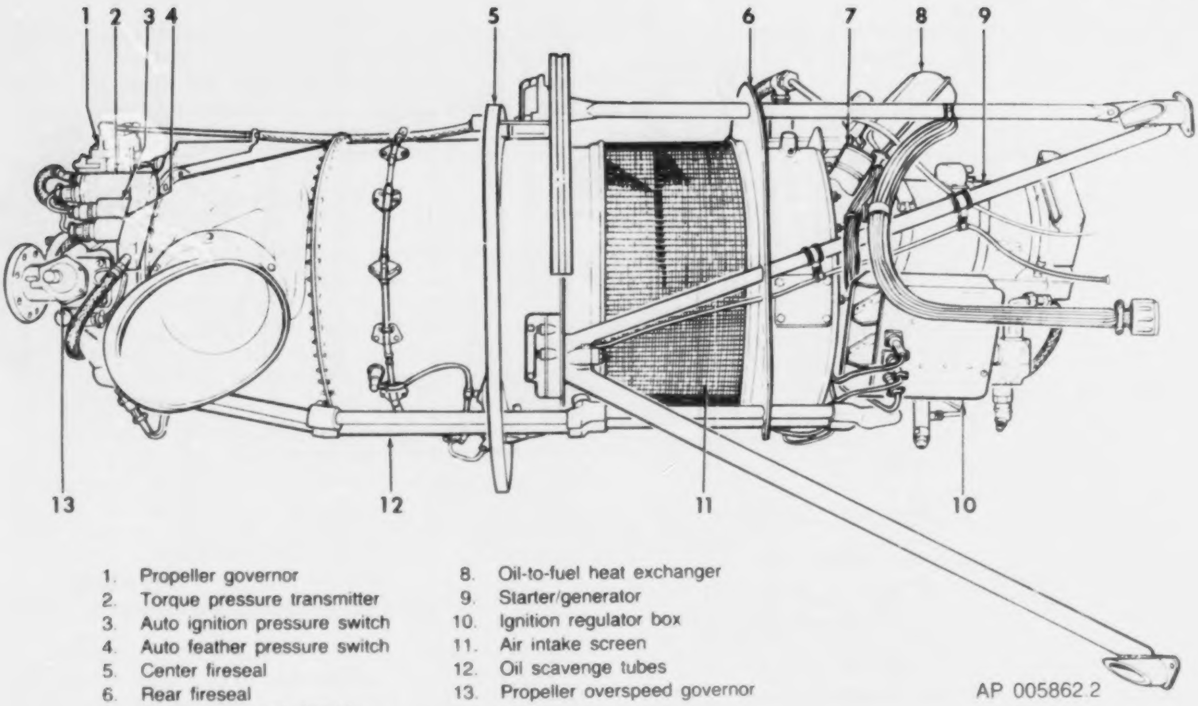
Each engine receives ram air ducted from an air scoop located within the lower section of the forward nacelle. Each oil cooler uses ram air secured by a separate air scoop attached to the lower section of the nacelle. Special components of the engine induction system protects the power plant from icing and foreign object damage.

2-21. Foreign Object Damage Control.

The engine has an integral air inlet screen designed to obstruct objects large enough to damage the compressor.

2-22. Power Plant Ice Protection Systems.

a. *Inertial Separators.* An inertial separation system is built into each engine air inlet to prevent moisture particles from entering the engine inlet plenum under freezing conditions. This is done by introducing a sudden turn in the airstream to the



1. Propeller governor
2. Torque pressure transmitter
3. Auto ignition pressure switch
4. Auto feather pressure switch
5. Center fireseal
6. Rear fireseal
7. Oil filler cap and dipstick
8. Oil-to-fuel heat exchanger
9. Starter/generator
10. Ignition regulator box
11. Air intake screen
12. Oil scavenge tubes
13. Propeller overspeed governor

Figure 2-10. T74-CP-700 Engine (sheet 1 of 2)

engine, causing the moisture particles to continue on undeflected because of their greater momentum and to be discharged overboard. During normal operation, a movable vane is raised out of the direct ran airstream. For cold weather (+ 5°C or below) operation in visible moisture, it should be lowered into the airstream. The anti-ice vanes are operated by individual T-handle, push-pull controls, located below the left subpanel. The controls are placarded LEFT ENG ICE VANE PULL TO EXT, PUSH TO RET, RIGHT ENG ICE VANE. PULL TO EXT, PUSH TO RET (fig. 2-7). Vane position during operation is indicated by the position of the T-handles, and a by a slight decrease in torque with the engine ice protection controls extended. The vanes should be either fully retracted or fully extended; there are no intermediate positions.

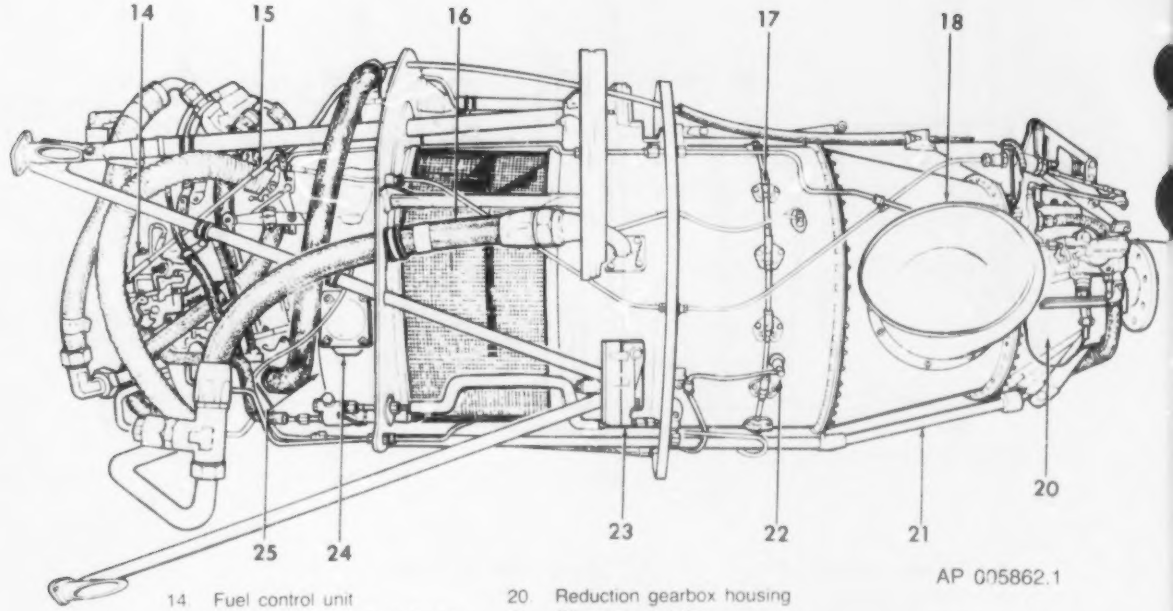
b. Engine Lip Boot Heat. The engine air inlet lip boots are electrically heated to prevent the formation of ice and consequent distortion of the airflow. The boots are operated by the two 5-ampere circuit breaker switches on the pilot's subpanel placarded: ENG LIP BOOT, LEFT-RIGHT. The circuit is connected through the right landing gear safety switch and is therefore operable only during flight. The circuit is protected by two 25-ampere circuit breakers, placarded LIP ANTI-ICE, LH-RH, located on the copilot's circuit breaker panel (fig. 2-18). During flight, when icing conditions are anticipated, position both ENG LIP BOOT heat switches ON (up), (fig. 2-7). Continue use as required and shut off when icing conditions are no longer present or anticipated.

c. Fuel Control Heat. Each fuel control's temperature compensating line is protected against ice by electrically heated jackets. Power is supplied to each fuel control air line heater by two HEAT switches, placarded FUEL CONTROL - LEFT and RIGHT on the pilot's subpanel (fig. 2-7). Fuel control heat should be turned on before all flight operations.

2-23. Engine Fuel Control System.

a. Description. The control system consists of an engine-driven primary (high pressure) fuel pump, an engine driven boost pump, a fuel control unit, and a fuel nozzle manifold. An automatic fuel dump valve and two drain valves are provided to drain residual fuel from the engine after shutdown or after a discontinued start.

b. Fuel Control Unit. One fuel control unit is on the accessory case of each engine. This unit is a hydro-mechanical metering device which determines the proper fuel schedule for the engine to pro-



14. Fuel control unit
15. Fuel control unit control rod
16. Bleed air line
17. Fuel manifold
18. Exhaust
19. Power turbine governor
20. Reduction gearbox housing
21. Oil pressure tube
22. Ignitor plug
23. Engine mount
24. Oil filter cover
25. Accessory gearbox housing

Figure 2-10. T74-CP-700 Engine (sheet 2 of 2)

duce the amount of power requested by the relative position of its power lever. The control of developed engine power is accomplished by adjusting the engine compressor turbine (N_1) speed. N_1 speed is controlled by varying the amount of fuel injected into the combustion chamber through the fuel nozzles. All fuel control operations are made by movement of the power and condition levers for a specific engine. Engine shutdown is accomplished by moving the appropriate condition lever to the full aft, FUEL CUT-OFF position, which shuts off the fuel supply.

2-24. Power Levers.

CAUTION

Moving the power levers into reverse range without the engines running may result in damage to the reverse linkage mechanisms.

Two power levers are located on the control pedestal (fig. 2-6). The left power lever incorporates a go-around (GA) button. These levers regulate power in the reverse, idle, and forward range, and operate so that forward movement increases engine power. Power control is accomplished through adjustment of the N_1 speed governor in the fuel control unit. Power is increased when N_1 RPM is increased. The power levers also control propeller reverse pitch. Distinct movement (pulling up and then aft on the power lever) by the pilot is required for reverse thrust. Placarding below the lever travel slots reads POWER. Upper lever travel range is designated INCR (increase), supplemented by an arrow pointing forward. Lower travel range is marked IDLE, LIFT and REVERSE. A placard below the lever slots reads: CAUTION-REVERSE ONLY WITH ENGINES RUNNING.

2-25. Condition Levers.

Two condition levers are located on the control pedestal (fig. 2-6). Each lever starts or stops the fuel supply, and controls the idle speed for its engine. The levers have three placarded positions: FUEL CUTOFF, LO IDLE, and HIGH IDLE. In the FUEL CUTOFF position, the condition lever controls the cutoff function of its engine-mounted fuel control unit. From LO IDLE to HIGH IDLE, they control the governors of the fuel control units to establish minimum fuel flow levels. LO IDLE position sets the fuel flow rate to attain 50% to 53% (at sea level) minimum N_1 and HIGH IDLE position sets the rate to attain 70% to 73% N_1 minimum N_1. The power lever for the corresponding engine can select N_1 from the respective idle setting to maximum power. An increase in low idle N_1 will be experienced at higher field evaluation.

2-26. Friction Lock Knobs.

Four friction lock knobs are located on the control pedestal to adjust friction drag for the engine and propeller control levers. One knob is below the propeller levers, one below the condition levers, and two under the power levers. When a knob is rotated clockwise, friction restraint is increased opposing movement of the affected lever as set by the pilot. Counterclockwise rotation of a knob will decrease friction drag thus permitting free and easy lever movement. Two FRICTION LOCK placards are located on the pedestal adjacent to the knobs (fig. 2-6).

2-27. Engine Fire Detection System.

A flame surveillance system is installed on each engine to detect external engine fire and provide alarm to the pilot. Both nacelles are monitored, each having a control amplifier and three detectors. Electrical wiring connects all sensors and control amplifiers to DC power and to the cockpit audio and visual alarm units. In each nacelle, one detector monitors the forward nacelle, a second monitors the upper accessory area, and a third the lower accessory area.

a. Fire emits an infrared radiation that will be sensed by the detector which monitors the area of origin. Radiation exposure activated the relay circuit of a control amplifier which causes signal power to be sent to cockpit alarms. An activated surveillance system will return to the standby state after the fire is out. The system includes a functional test switch and has circuit protection through the FIRE DETECTOR circuit breaker.

b. Warning of internal nacelle fire is provided as follows: A warning horn sounds in the cockpit; simultaneously the red MASTER WARNING lights on the instrument panel start flashing. These alarms are accompanied by the continuous illumination of a red FIRE L ENG or FIRE R ENG light also on the annunciator panel; (fig. 2-22). Fire detector circuits are protected by a single 3-ampere circuit breaker, placarded FIRE WARN POWER, located on the right subpanel (fig. 2-7).

c. An erroneous indication of engine fire may be encountered if an engine cowling is not closed properly, or if the aircraft is headed toward a strong external light source. In this circumstance, close the cowling and/or change the aircraft heading away from the light source.

d. One rotary switch placarded TEST SWITCH FIRE DETECTION - OFF 1, 2, 3, on the control pedestal, is provided to test the engine fire detection system (fig. 2-6). Before battery power must be on and the FIRE WARN POWER circuit breaker must be in. Switch position 1, checks area forward of the air intake of each nacelle, including circuits to the cockpit alarm and indication devices. Switch position 2, checks the circuits for the upper accessory compartment of each nacelle. Switch position 3, checks the circuits for the lower accessory compartment of each nacelle. Each numbered switch position will initiate the cockpit alarm and indications previously described.

2-28. Oil Supply System.

a. The engine oil tank is intergal with the air-inlet casting located forward of the accessory gearbox. Oil for propeller operation, lubrication of the reduction gearbox and engine bearings is supplied by an external line from the high pressure pump. Two scavenge lines return oil to the tank from the propeller reduction gearbox. A non-congealing external oil cooler keeps the engine oil temperature within the operating limits. The capacity of each engine oil tank is 9.2 quarts and includes an expansion space of 0.72 quarts. The total system capacity for each engine, which includes the oil tank, oil cooler, lines, etc., is 14 quarts - of which 6 quarts are usable. The oil level is indicated by a dipstick attached to the oil filler cap. For oil grade, specification and servicing points, refer to Section XII, Servicing.

b. The oil system of each engine is coupled into a heat exchanger unit (radiator) of fin-and-tube design. These exchanger units are the only airframe mounted part of the oil system and are attached to the nacelles below the engine air intake. Each heat exchanger incorporates a thermal bypass which assists in maintaining oil at the proper temperature range for engine operation.

2-29. Engine Chip Detection System.

A magnetic chip detector is installed in the bottom of each engine reduction gearbox to warn the pilot of oil contamination and possible engine failure. The sensor is an electrically insulated gap immersed in the oil functioning as a normally-open switch. If a large metal chip or a mass of small particles bridge the detector gap a circuit is completed, sending a signal to illuminate an annunciator panel yellow light placarded CHIP DETECTED, LEFT

ENGINE or RIGHT ENGINE and the FAULT WARN lights (fig. 2-22). Chip detector circuits are protected by a single 5-ampere circuit breaker, placarded CHIP DETECTOR, on the right subpanel (fig. 2-7).

2-30. Engine Ignition System.

a. Description. The basic ignition system consists of a current regulator unit, two igniter plugs, two shielded ignition cables, pilot-controlled IGN & ENGINE START/STARTER ONLY switches and the IGNITER POWER switches or autoignition switches, if installed. Activation of an IGN & ENGINE START switch will cause coils in the respective igniter plugs to heat, igniting the fuel/air mixture sprayed into the combustion chamber by the fuel nozzles. The ignition system is activated for ground and air starts, but is switched off after combustion light-up.

b. Ignition and Engine Start Switches. One three-position toggle switch for each engine on the left subpanel, will initiate starter motoring and ignition in the IGN & ENGINE START position, or will motor the engine in the STARTER ONLY position (fig. 2-7). The switches are placarded LEFT AND RIGHT to designate the appropriate engine. The IGN & ENGINE START switch position completes the starter circuit for engine rotation, energizes the igniter plugs for fuel combustion, and activates the appropriate IGN IND light on the annunciator panel. IGN ON light on the annunciator panel. At STOP position the switch is "off". Two 20-ampere circuit breakers on the copilot's circuit breaker panel placarded IGNITERS, LH and RH, protect ignition circuits. Two 5-ampere circuit breakers on the right subpanel, placarded START CONT - LH and RH, protect starter control circuits (fig. 2-18).

2-31. Autoignition System.

If "armed", the autoignition system automatically provides combustion re-ignition of either engine should accidental flameout occur. The system is not essential to normal engine operation, but is used to reduce the possibility of power loss due to icing or other conditions. Each engine has a separate autoignition control switch, a green PRESS-TO-TEST light and a yellow indicator on the annunciator panel. Autoignition is accomplished by energizing the two igniter heating elements in each engine.

a. Autoignition Switches. Two switches placarded ENG AUTOIGNITION, LEFT and RIGHT, with positions ARM and OFF, are located on the left subpanel (fig. 2-7). ARM position initiates a readiness mode for the autoignition system of te corresponding engine. OFF position disarms the system. Each switch is protected by a corresponding START CONT. LH or RH circuit breaker of 5-amperes on the right subpanel (fig. 2-18).

b. Autoignition Lights. Two green press-to-test lights are positioned below the autoignition switches (fig. 2-7). Each light, although not placarded, is associated only with the switch directly above it and will illuminate when that switch is placed in the ARM position. Illumination of a light indicates that the autoignition system is in a "ready condition". If an ARMED autoignition system changes from "ready ignition" to an "operating condition" energizing the two igniter elements in an engine, the green light will extinguish and a corresponding yellow annunciator panel light will illuminate. The annunciator panel light is placarded LH or RH IGN IND and indicates that the igniters are energized. The The autoignition system is triggered from a "ready condition" to an "operating condition" when engine torque drops below 12 PSI (350 to 450 ft-lb torque). Therefore, when an autoignition system is ARMED, the igniters will be energized continuously during the time when an engine is operating at a level below 12 PSI (350 to 450 ft-lb torque). The autoignition lights are protected by 5-ampere START CONT - LH and RH circuit breakers on the right subpanel (fig. 2-18).

c. Ignition-On Indicators. The ignition on state is confirmed by an illuminated yellow function indicator on the annunciator panel placarded LH or RH IGN IND (fig. 2-22).

2-32. Engine Starter-Generators.

One starter-generator is mounted on each engine accessory drive section. Each is able to function either as a starter or as a generator. In starter function, a stabilized minimum of 22 volts DC is required to power rotation. In generator function, each unit is capable of 250 amperes DC output. The START function is protected by 5-ampere START CONT - LH and RH circuit breakers on the right subpanel. When starting function is selected, the starter-generator receives electrical power from either the aircraft battery or an external power source. When the generating function is selected, the starter-generator provides electrical power to its respective bus. For additional description of the starter-generator system, refer to Section IX.

2-33. Engine Instruments.

Instruments which display engine conditions or start of operation are discussed in the following paragraphs. Engine instruments are located horizontally in the upper-center section and vertically on the pilot's side of the instrument panel.

a. Interstage Turbine Temperature Indicators. Two interstage turbine temperature (ITT) gages on the instrument panel are calibrated in degrees celsius units (fig. 2-22). Each gage is connected to ten thermocouple probes located in the hot gases between the turbine wheels. The ITT gages register the temperature present between the compressor turbine and power turbine for the corresponding engine.

b. Engine Torquemeters. Two torquemeters on the instrument panel indicate torque applied to the propeller shafts of the respective engines (fig. 2-22). Each gage shows torque by foot-pound measure using 100 pound graduations and is actuated by an electrical signal from a pressure sensing system located in the respective propeller reduction gear case. Torquemeters are protected separately by a 1-ampere circuit breaker, placarded TORQUEMETER LH, RH, on the copilot's circuit breaker panel (fig. 2-18).

c. Turbine Tachometers. Two tachometers on the instrument panel register compressor turbine RPM (N_1) for the respective engine (fig. 2-22). These indicators register turbine RPM as a percentage of maximum gas generator RPM. Each instrument is slaved to a tachometer generator attached to the respective engine.

d. Oil Pressure Indicators. Two gages on the instrument panel register oil pressure in PSI as taken from the delivery side of the main oil pressure pump (fig. 2-22). Each gage is connected to a pressure transmitter installed on the respective engine. Both instruments are protected by a single, 1-ampere circuit breaker, placarded OIL PRESS, on the copilot's circuit breaker panel (fig. 2-18).

e. Oil Temperature Indicators. Two oil temperature gages (fig. 2-22) on the instrument panel are connected to separate thermal sensor units attached to the respective engines. Each gage registers oil temperature in °C as it leaves the delivery side of the oil pressure pump. Both gages are protected by a single 5-ampere circuit breaker, placarded OIL TEMP IND, on the right subpanel (fig. 2-7).

f. Fuel Flow Indicators. Two gages on the instrument panel register the rate of flow for consumed fuel as measured by sensing units coupled into the fuel supply lines of the respective engines (fig. 2-22). The fuel flow indicators are calibrated in increments of hundreds of pounds per hour. Both circuits are protected by a single, 1-ampere circuit breaker, placarded FUEL FLOW, on the copilot's circuit breaker panel (fig. 2-18).

g. Fuel Pressure Indicators. Two gages on the instrument panel register boost pump pressure sensed by pressure transmitters (fig. 2-22). Gages and transmitters are protected by 1-ampere fuses, placarded FUEL PRESS on the copilot's circuit breaker and fuse panel.

SECTION IV. FUEL SYSTEM

2-34. Fuel Supply System.

The engine fuel supply system (fig. 2-11) consists of two identical systems sharing a common fuel management panel and fuel crossfeed manifold. Each fuel system consists of four inter-connected wing tanks, a nacelle tank, an engine-driven boost pump mounted on each engine, an auxiliary fuel pump located within the nacelle tank, a fuel transfer pump located within the inboard wing tank, a fuel heater (engine oil-to-fuel heat exchanger unit), a tank vent system, a tank vent heating system and interconnecting wiring and plumbing.

a. Boost Pumps.

CAUTION

Engine operation using only the engine-driven fuel pump without boost fuel pressure is limited to 10 cumulative hours. All time in this category shall be entered on DA Form 2408-13 for the attention of maintenance personnel.

A submerged boost pump in each nacelle tank supplies fuel under pressure to an engine-driven high pressure pump on each engine. Engine operation will quickly terminate if the engine-driven high pressure pump fails. However, if a boost pump fails, engine operation can be sustained by the engine-mounted pump alone for a limited time. The boost pumps are protected by two 5-ampere circuit breakers placarded BOOST PUMP located on the fuel system circuit breaker panel (fig. 2-12).

b. Fuel Transfer Pumps. A submerged, electrically-operated fuel transfer pump is located in each inboard wing tank. Fuel level in the nacelle tank is automatically maintained by gravity feed from the wing tanks. However, approximately 28 gallons (182 pounds) in each of the inboard wing tanks will not gravity feed. This fuel is moved by the fuel transfer pumps. These transfer pumps are energized and de-energized by a fuel quantity sensor located in each nacelle tank (when the transfer pump switches are in the ON position). Whenever the nacelle tank quantity drops to 8 gallons (52 pounds), the transfer pump is automatically energized and begins transfer of fuel from the wing tanks to the nacelle tank. Fuel transfer continues until the fuel quantity in the nacelle tank reaches 24 gallons (156 pounds). The fuel transfer pumps are protected by two 5-ampere circuit breakers placarded FUEL TRANSFER, located on the fuel system circuit breaker panel (fig. 2-12).

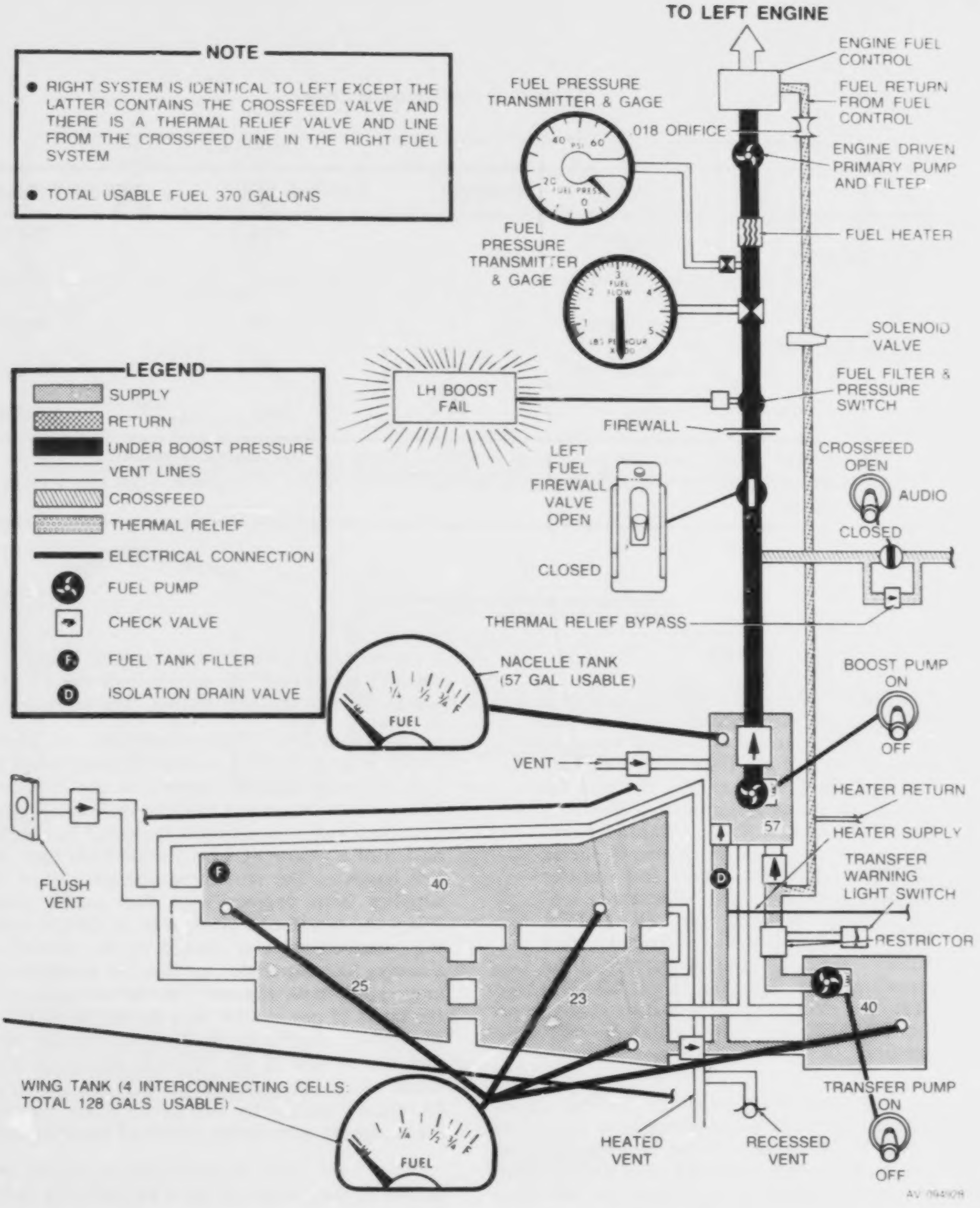
c. Fuel Management Panel (fig. 2-12). The fuel management panel is located on the cockpit sidewall, on the left side of the pilot. It contains the fuel gages, boost pump switches, transfer pump switches, transfer test light, crossfeed valve switch, firewall shutoff valve switches, and eight circuit breakers protecting the fuel system.

(1) Boost pump switches. Two switches on the fuel management panel control a submerged pump in corresponding nacelle tanks. Each is a two-position toggle switch of the lever-lock type. At each position, the toggle lever is restrained to prevent accidental change of setting. To reposition the switch, pull the toggle lever outward, move to the new setting, then release. The switches are placarded BOOST PUMP, ON and OFF (fig. 2-12), and are both ON during normal operation of the aircraft. If boosted fuel pressure is not available, a flashing FAULT WARN light starts and a red LH BOOST FAIL or RH BOOST FAIL light illuminates on the annunciator panel.

(2) Fuel transfer pump switches. Two switches on the fuel management panel, placarded TRANSFER PUMP, ON and OFF, control "arming" of the fuel transfer pumps in normal mode, (fig. 2-12). Each is a two-position toggle switch of the lever-lock type. At each position, the toggle lever is restrained to prevent accidental change of setting. To reposition the switch, pull the toggle lever outward, move to the new setting, then release. Transfer pumps transfer fuel from the center wing tanks into the corresponding nacelle tanks. During normal system operation, both switches are ON, which allows transfer pump ON-OFF function to be automatically controlled by a quantity sensor in each nacelle tank so that a proper fuel level is maintained. If either transfer pump fails to operate, when switched ON by its quantity sensor, a fault condition is indicated to the pilot. Fault indication consists of a flashing red FAULT WARN light and a steady illuminated LH NO FUEL TRANSFER or RH NO FUEL TRANSFER light on the annunciator panel (fig. 2-22).

(3) Fuel transfer test switch. A switch, placarded TRANSFER TEST (fig. 2-12) on the fuel management panel provides a means of checking the operation of either fuel transfer system. This switch is a three-position toggle type, spring-loaded to the OFF (center) position. When positioned to either L (left) or R (right) the switch applies power to the selected transfer pump by bypassing the normal automatic circuit. If the nacelle tank is full, the selected transfer pump will be energized momentarily, which is enough to establish the operating status of that transfer system, indicated by the momentary flash of a yellow LH NO FUEL TRANSFER or RH NO FUEL TRANSFER indicator light on the annunciator panel (fig. 2-22).

(4) No Fuel transfer indicator lights. When all usable fuel has been transferred from a wing tank system, a sensing switch detects the pressure drop in the fuel transfer line. After 30 seconds the affected transfer pump is shut off. and a yellow light on the annunciator panel illuminates: LH NO FUEL TRANSFER or RH NO FUEL TRANSFER.



NOTE

- RIGHT SYSTEM IS IDENTICAL TO LEFT EXCEPT THE LATTER CONTAINS THE CROSSFEED VALVE AND THERE IS A THERMAL RELIEF VALVE AND LINE FROM THE CROSSFEED LINE IN THE RIGHT FUEL SYSTEM
- TOTAL USABLE FUEL 370 GALLONS

TO LEFT ENGINE
ENGINE FUEL CONTROL
FUEL RETURN FROM FUEL CONTROL
FUEL PRESSURE TRANSMITTER & GAGE
.018 ORIFICE
ENGINE DRIVEN PRIMARY PUMP AND FILTER
40 PSI 60
20 FUEL PRESS
0
FUEL PRESSURE TRANSMITTER & GAGE
FUEL HEATER
3 FUEL FLOW
2
4
1
5
LBS PER HOUR X 100
SOLENOID VALVE
LEGEND
SUPPLY
RETURN
UNDER BOOST PRESSURE
VENT LINES
CROSSFEED
THERMAL RELIEF
ELECTRICAL CONNECTION
FUEL PUMP
CHECK VALVE
F FUEL TANK FILLER
D ISOLATION DRAIN VALVE
LH BOOST FAIL
FUEL FILTER & PRESSURE SWITCH
FIREWALL
CROSSFEED OPEN
AUDIO
CLOSED
LEFT FUEL FIREWALL VALVE OPEN
CLOSED
THERMAL RELIEF BYPASS
NACELLE TANK (57 GAL USABLE)
¼ ½ ¾ F
FUEL
BOOST PUMP ON
OFF
VENT
57
HEATER RETURN
HEATER SUPPLY
TRANSFER WARNING LIGHT SWITCH
RESTRICTOR
FLUSH VENT
F
40
D
25
23
40
TRANSFER PUMP ON
OFF
WING TANK (4 INTERCONNECTING CELLS: TOTAL 128 GALS USABLE)
¼ ½ ¾ F
FUEL
HEATED VENT
RECESSED VENT
AV 094108

Figure 2-11. Fuel System Schematic

Table 2-1. Fuel Quantity Data.

	TANKS	NUMBER	USABLE FUEL	**WEIGHT/POUNDS
LEFT ENGINE	Wing tanks		128	832.0
	Nacelle tank	1	57	370.5
RIGHT ENGINE	Wing tanks	4	128	832.0
	Nacelle tank	1	57	370.5
	*Totals	10	370	2405.0

* Unusable fuel quantity and weight (3.6 gallons, 24 pounds not included in totals).

** Fuel weight is based on standard day conditions at 6.5 pounds per U.S. gallon. Total fuel system capacity is 373.6 gallons.

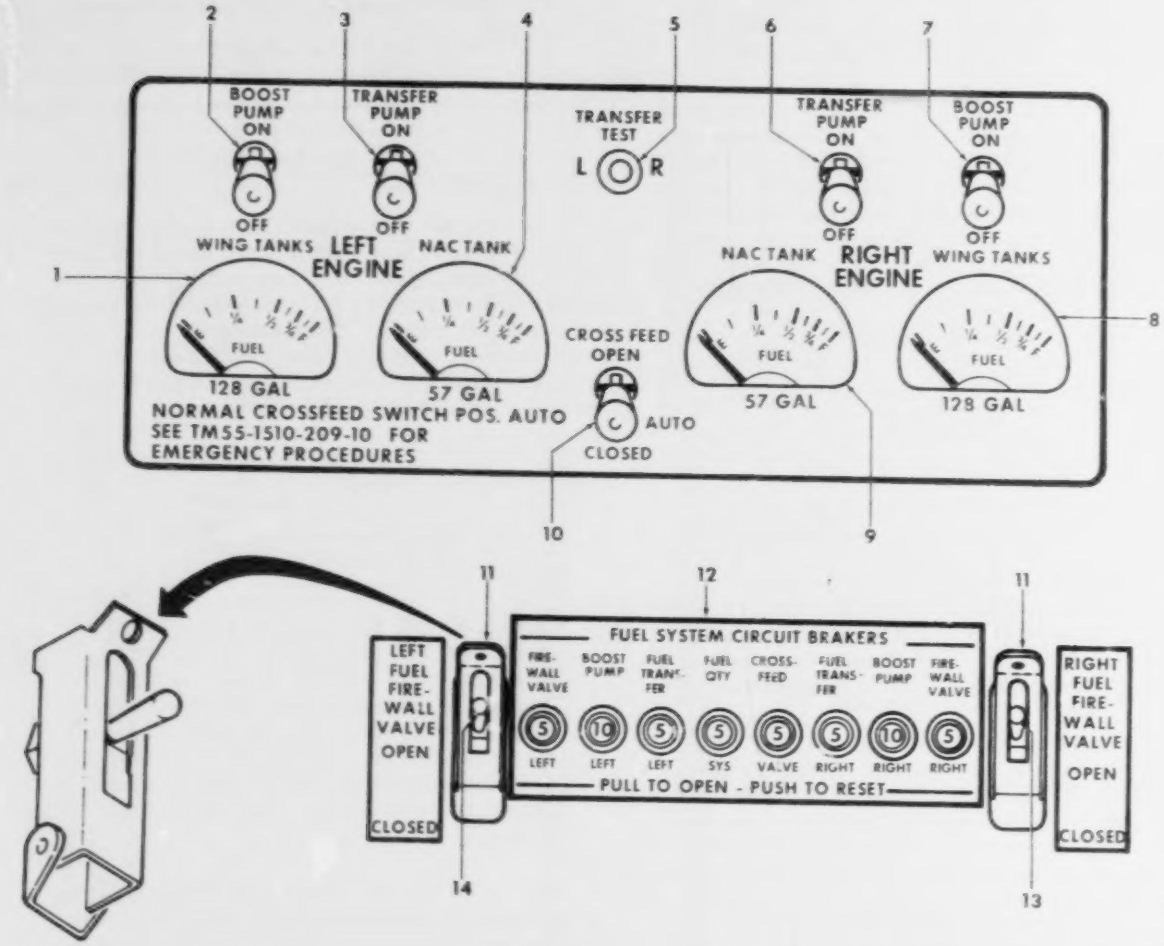
NOTE

The NO FUEL TRANSFER light will also serve as an operation indicator for the designated transfer pump. If the light illuminates, and the respective wing take gage does not show empty, the transfer pump has stopped transferring fuel into the nacelle tank. A positive transfer pump test (as accomplished in chapter 8 during ENGINE RUNUP) without fuel transfer indicates a nacelle tank fuel quantity sensor failure. Holding the TRANSFER TEST switch to ON will override the fuel quantity sensors and allow transfer of the remaining fuel. The NO FUEL TRANSFER light may be extinguished by placing the TRANSFER PUMP switch to OFF position.

(5) Fuel crossfeed switch. The fuel crossfeed system (fig. 2-13) is controlled by a 3-position switch (fig. 2-12) located on the fuel management panel, placarded OPEN, CLOSED and AUTO. With this switch, the crossfeed valve may be controlled manually or automatically. The switch also has a lever-lock toggle feature. At each position, the toggle is restrained to prevent an accidental change of setting. To reposition the switch, pull the toggle outward, move to the new setting, then release.

Under normal flight conditions, the crossfeed switch is set at AUTO, so that if either boost pump fails, the drop in line pressure on the effected side will cause the crossfeed valve to open automatically. Crossfeed valve operation is indicated by the illumination of a yellow FUEL CROSSFEED light. When this happens, the remaining operable boost pump supplies both engines with fuel under pressure. When the crossfeed switch is set at OPEN position, the crossfeed valve is opened in the manual mode allowing fuel to transfer, so that fuel in either system may supply both engines. Fuel is not crossfed from the tanks of one system into the tanks of the opposite system, but rather is pumped directly into the fuel supply line at the opposite engine at a point ahead of the line check valve. With the switch in the CLOSED position, the two halves of the fuel system are separated, preventing crossfeed between systems.

(6) Fuel crossfeed indicator light. Illumination of the yellow FUEL CROSSFEED indicator light on the annunciator panel (fig. 2-22) indicates that the electrically operated crossfeed valve is open.


2
3
4
5
6
7
BOOST PUMP ON
OFF
TRANSFER PUMP ON
OFF
TRANSFER TEST
L
R
TRANSFER PUMP ON
OFF
BOOST PUMP ON
OFF
WING TANKS
LEFT ENGINE
NAC TANK
NAC TANK
RIGHT ENGINE
WING TANKS
1
8
FUEL
128 GAL
FUEL
57 GAL
CROSS FEED OPEN
AUTO
CLOSED
FUEL
57 GAL
FUEL
128 GAL
NORMAL CROSSFEED SWITCH POS. AUTO
SEE TM55-1510-209-10 FOR
EMERGENCY PROCEDURES
10
9
11
12
11
FUEL SYSTEM CIRCUIT BRAKERS
FIRE-WALL VALVE
BOOST PUMP
FUEL TRANS-FER
FUEL QTY
CROSS-FEED
FUEL TRANS-FER
BOOST PUMP
FIRE-WALL VALVE
5
10
5
5
5
5
10
5
LEFT
LEFT
LEFT
SYS
VALVE
RIGHT
RIGHT
RIGHT
PULL TO OPEN - PUSH TO RESET
LEFT FUEL FIRE-WALL VALVE
OPEN
CLOSED
RIGHT FUEL FIRE-WALL VALVE
OPEN
CLOSED
14
13

AV 094929

1. Left wing tanks (4) fuel quantity gage
2. Left submerged fuel boost pump switch
3. Left fuel transfer pump switch
4. Left nacelle tank fuel quantity gage
5. Left or right fuel transfer test switch
6. Right fuel transfer pump switch
7. Right submerged fuel boost pump switch
8. Right wing tanks (4) fuel quantity gage
9. Right nacelle tank fuel quantity gage
10. Fuel crossfeed valve switch
11. Firewall switch cover guard
12. Fuel system circuit breaker panel
13. Right fuel firewall valve switch
14. Left fuel firewall valve switch

Figure 2-12. Fuel Management Panel

NOTE

The FUEL CROSSFEED light may remain illuminated if the crossfeed valve closes due to malfunction. The same circuit that opens the crossfeed valve also illuminates the FUEL CROSSFEED light.

(7) Fuel quantity indicators. Four fuel quantity gages are mounted on the fuel management panel (fig. 2-12). All gages are calibrated in quarters of total tank capacity. Two gages indicate total quantity of each fuel system: one gage indicating fuel quantity of the nacelle tank and the other indicating fuel quantity of the four interconnected wing tanks. Fuel quantity data is supplied by Table 2-1.

(8) Firewall shutoff valves.

CAUTION

Do not use the firewall shutoff valve to shut down an engine, except in an emergency. The engine-driven high-pressure fuel pump obtains essential lubrication from fuel flow. When an engine is operating, this pump may be severely damaged (while cavitating) if the firewall valve is closed before the condition lever is moved to the FUEL CUTOFF position.

Two guarded switches, placarded LEFT FUEL FIREWALL VALVE and RIGHT FUEL FIREWALL VALVE, on the fuel management panel, (fig. 2-12), are provided to give the pilot electrical fuel shutoff capability at each engine firewall. Each switch is a two-position unit controlling the corresponding firewall shutoff valve. OPEN position opens the firewall shutoff valve admitting fuel to the engine. In the CLOSED position fuel flow to the affected engine is cut off, thereby isolating the fuel supply from the engine (fig. 2-13), although the isolated fuel may be supplied to the opposite engine by crossfeed. A hinged red-colored metal guard engages each firewall valve switch toggle when the switch in in the OPEN position. This guard prevents inadvertent movement of the switch to the CLOSED position. The guard must be manually disengaged from the switch toggle to move the switch to the CLOSED position.

d. Fuel Tank Sump Drains. The fuel system tanks and interconnecting lines may be drained of moisture condensate and sediment by means of 10 drains (plus two for the ferry system, when installed), located at the system low points on the nacelle tanks, wing tanks and at the fuel filter drain at the inertial separator air bypass duct.

e. Fuel Vent System. Three fuel vents are located under each wing. One serves both the nacelle and wing tanks, and is protected against icing conditions by an electric heating element. (Refer to Section VII Utility Systems for fuel system anti-icing information.)

f. Thermal Pressure Relief Valve. Volume expansion in the fuel system is relieved by a thermal pressure relief valve. Normally, thermal expansion occurs only during hot weather while the aircraft is static on the ground.

g. Engine Oil-to-Fuel Heat Exchanger. An engine oil-to-fuel heat exchanger, located on each engine accessory case, operates continuously and automatically to heat the fuel delivered to the engine sufficiently to prevent the freezing of any water which it might contain. The temperature of the delivered fuel is thermostatically regulated to remain between + 21°C and + 32°C.

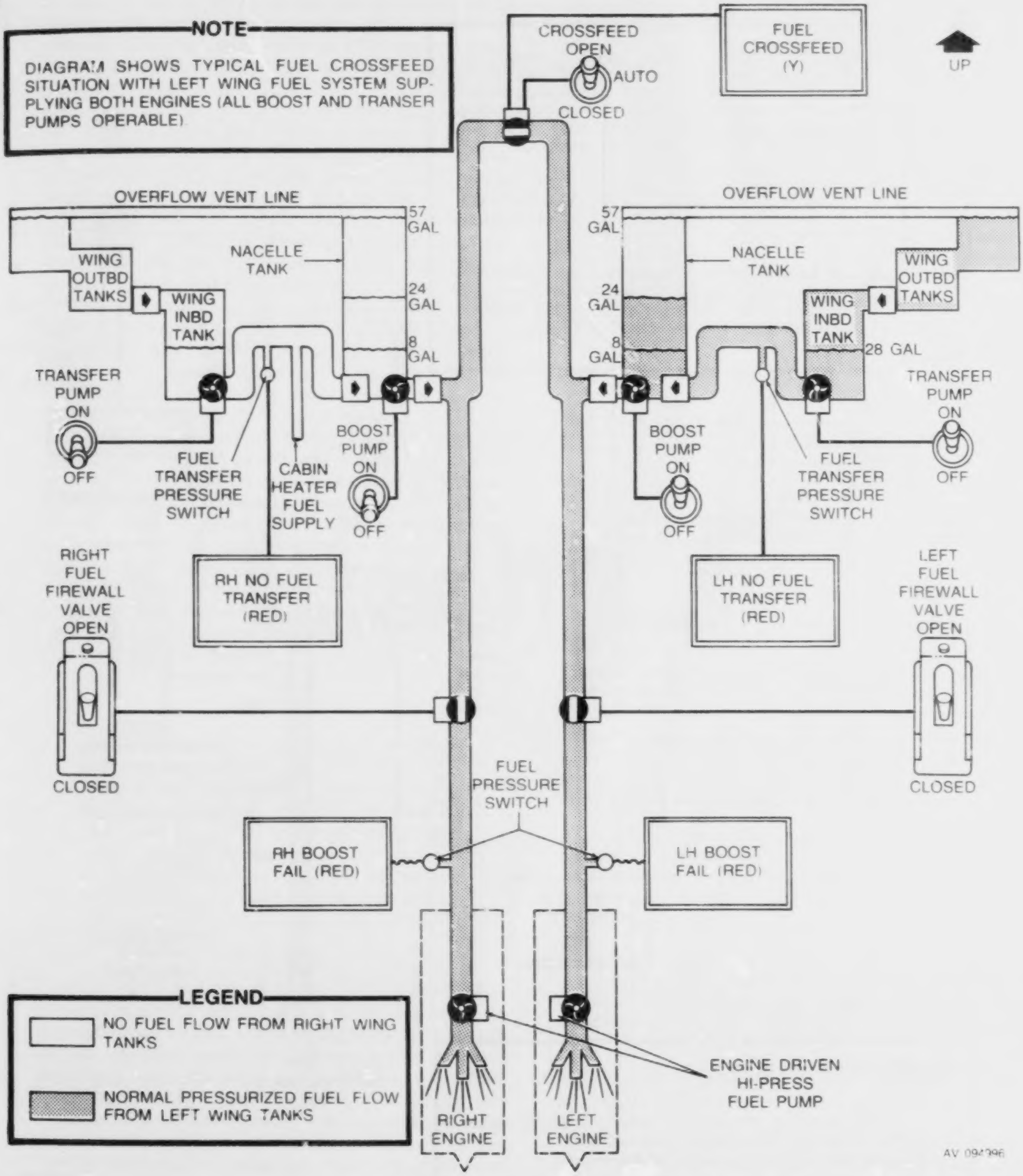
2-35. Fuel Management

CAUTION

During normal fuel system operation all usable fuel of each system can be used. However, if a transfer pump becomes inoperative, approximately 28 gallons of wing fuel from the respective system cannot be used because gravity feed will stop with approximately 28 gallons of fuel remaining within the respective wing tanks (fig. 2-14).

a. Fuel Transfer System. Fuel used from the nacelle tanks is replenished by gravity feed alone, until the level within the tank is depleted to 8 gallons (52 pounds) (fig. 2-14). At the 8 gallon (52 pound) level, the low switch position on the level sensor float is actuated which causes fuel transfer to start. When the fuel quantity rises to 24 gallons (156 pounds), transfer action is cutoff by the second switch position on the float. Unless the pilot uses manual transfer control after the first transfer cycle, all subsequent fuel transfer will maintain quantity within the nacelle tanks at a level between 8-24 gallons (52 - 156 pounds), until all fuel is used from the wing tanks.

(1) Transfer pump manual operation. While sufficient fuel remains in the wing tanks, the pilot may use manual control to refill the nacelle tanks to capacity. Refilling must be conducted with the TRANSFER PUMP switch on, and by placing the TRANSFER TEST switch at L or R position



NOTE

DIAGRAM SHOWS TYPICAL FUEL CROSSFEED SITUATION WITH LEFT WING FUEL SYSTEM SUPPLYING BOTH ENGINES (ALL BOOST AND TRANSER PUMPS OPERABLE)

LEGEND

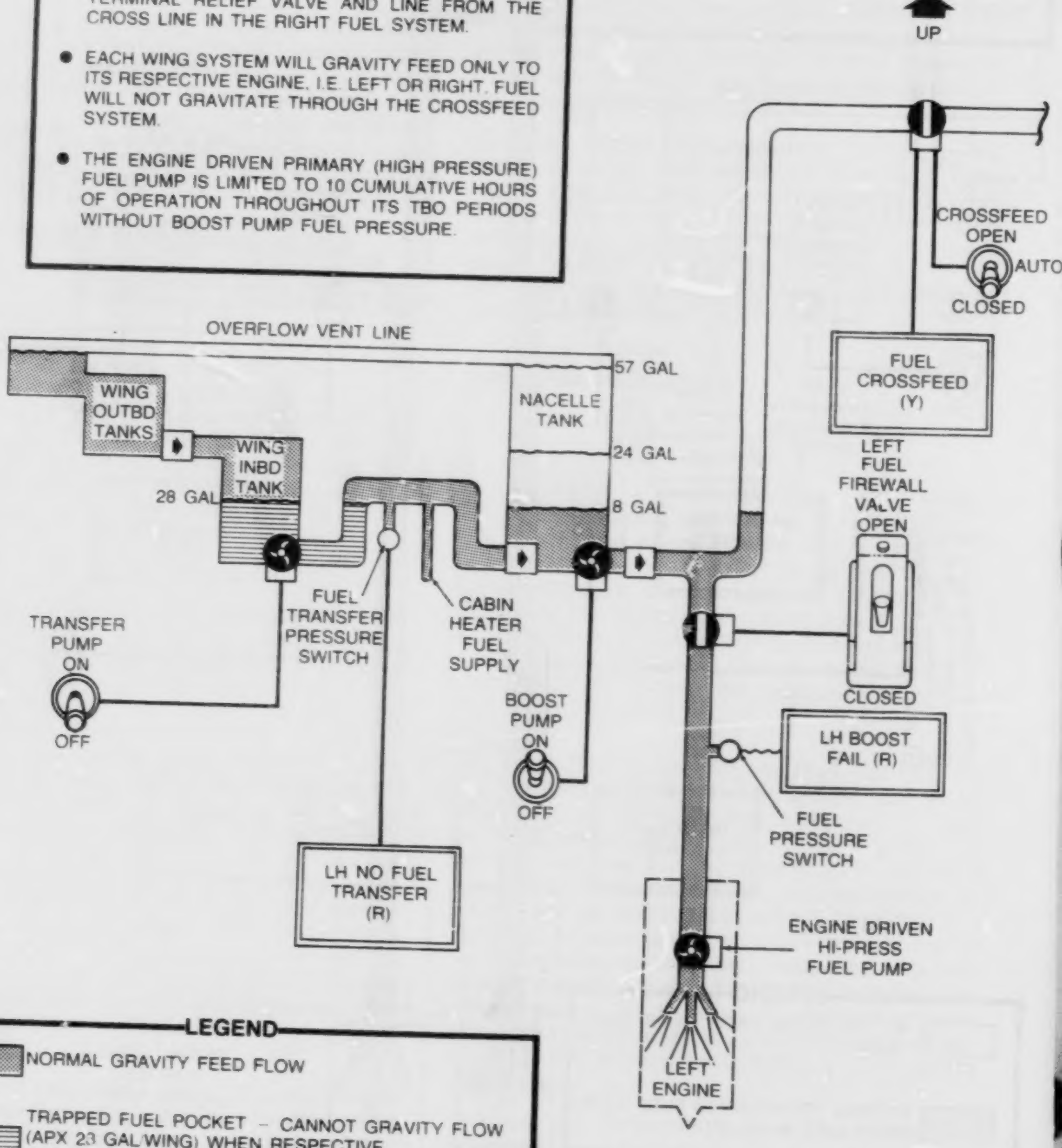
- ☐ NO FUEL FLOW FROM RIGHT WING TANKS
- ▨ NORMAL PRESSURIZED FUEL FLOW FROM LEFT WING TANKS

CROSSFEED
OPEN
AUTO
CLOSED
FUEL CROSSFEED (Y)
UP
OVERFLOW VENT LINE
57 GAL
WING OUTBD TANKS
NACELLE TANK
WING INBD TANK
24 GAL
8 GAL
TRANSFER PUMP ON
OFF
FUEL TRANSFER PRESSURE SWITCH
CABIN HEATER FUEL SUPPLY
BOOST PUMP ON
OFF
RH NO FUEL TRANSFER (RED)
RIGHT FUEL FIREWALL VALVE OPEN
CLOSED
OVERFLOW VENT LINE
57 GAL
NACELLE TANK
24 GAL
8 GAL
WING OUTBD TANKS
WING INBD TANK
28 GAL
TRANSFER PUMP ON
OFF
BOOST PUMP ON
OFF
FUEL TRANSFER PRESSURE SWITCH
LH NO FUEL TRANSFER (RED)
LEFT FUEL FIREWALL VALVE OPEN
CLOSED
FUEL PRESSURE SWITCH
RH BOOST FAIL (RED)
LH BOOST FAIL (RED)
RIGHT ENGINE
LEFT ENGINE
ENGINE DRIVEN HI-PRESS FUEL PUMP
AV 094096

Figure 2-13. Crossfeed Fuel Flow

NOTE

- DIAGRAM SHOWS TYPICAL GRAVITY FEED FUEL FLOW FOR THE LEFT SIDE. RIGHT SYSTEM IS IDENTICAL TO LEFT EXCEPT THE FORMER CONTAINS THE CROSSFEED VALVE AND THERE IS A TERMINAL RELIEF VALVE AND LINE FROM THE CROSS LINE IN THE RIGHT FUEL SYSTEM.
- EACH WING SYSTEM WILL GRAVITY FEED ONLY TO ITS RESPECTIVE ENGINE, I.E. LEFT OR RIGHT. FUEL WILL NOT GRAVITATE THROUGH THE CROSSFEED SYSTEM.
- THE ENGINE DRIVEN PRIMARY (HIGH PRESSURE) FUEL PUMP IS LIMITED TO 10 CUMULATIVE HOURS OF OPERATION THROUGHOUT ITS TBO PERIODS WITHOUT BOOST PUMP FUEL PRESSURE.


UP
CROSSFEED OPEN
AUTO
CLOSED
FUEL CROSSFEED (Y)
OVERFLOW VENT LINE
57 GAL
WING OUTBD TANKS
WING INBD TANK
NACELLE TANK
24 GAL
28 GAL
8 GAL
LEFT FUEL FIREWALL VALVE OPEN
CLOSED
TRANSFER PUMP ON
OFF
FUEL TRANSFER PRESSURE SWITCH
CABIN HEATER FUEL SUPPLY
BOOST PUMP ON
OFF
LH BOOST FAIL (R)
FUEL PRESSURE SWITCH
LH NO FUEL TRANSFER (R)
ENGINE DRIVEN HI-PRESS FUEL PUMP
LEFT ENGINE

LEGEND

▨ NORMAL GRAVITY FEED FLOW

▤ TRAPPED FUEL POCKET – CANNOT GRAVITY FLOW (APX 23 GAL/WING) WHEN RESPECTIVE TRANSFER PUMP IS NOT OPERATING

AV 094997

Figure 2-14. Gravity Fuel Flow

(whichever applies). If the TRANSFER TEST switch is held at the L or R setting momentarily, then released, the initiated fuel transfer will be shutoff by either the 24 or 57 gallon (156 or 370.5 pound) float switch position, whichever the rising fuel level encounters first. If the TRANSFER TEST switch is manually retained in the ON position fuel transfer will continue until the switch is released. In this instance, the transfer pump shutoff circuits on the 24 and 57 gallon (156 and 370.5 pound) float switches are bypassed, and if enough fuel is present in the wing tanks, the nacelle tank may be overfilled, resulting in excess fuel flowing through the vent lines back into the wing tanks. A safe continuous-transfer loop is thus established, but is not a recommended procedure. Unless a nacelle tank is full to capacity whenever a TRANSFER PUMP switch is turned ON, after an OFF period, the affected pump will start an immediate transfer cycle. Transfer will continue until fuel within the receiving tank rises enough to actuate a float-switching position which was not already exceeded by the fuel level when the TRANSFER PUMP switch was placed ON. If fuel quantity before the start of transfer was between 8-24 gallons (52-156 pounds), transfer power will be cut off at the 24 gallon (156 pound) float-switching level. However, if quantity within a nacelle tank is above the 24 gallon (156 pound) switching level, when the TRANSFER PUMP switch is turned ON, a transfer will initiate, continuing to fill the tank until the top float-switching position of 57 gallons (370.5 pounds) is reached.

NOTE

With full tanks, two pilots, and an empty aircraft, the center-of-gravity is at the forward limit. The automatic transfer system maintains CG within limits by limiting the quantity of fuel to 24 gallons in each nacelle tank. However, if the manual over-ride is used to maintain full nacelle tanks during the load condition described above, the aircraft forward CG limit will be exceeded.

(2) *Top nacelle fuel quantity sensor failure (continuously full nacelle tank).* If fuel transfer into a nacelle tank should not be terminated by actuation of the top level quantity sensor, over-fill fuel will flow back into the wing tanks through vent lines. Operation would stabilize into a continuous fuel transfer loop. A continuously full nacelle tank, monitored on the gage, would indicate this condition and can be corrected by using the following procedure:

(a) Reset the appropriate TRANSFER PUMP switch to OFF.

(b) When the gage of the affected tank indicates a quantity below 24 gallon (156 pounds), reset the TRANSFER PUMP switch to ON. This will reset the automatic level control between the limits of 8-24 gallons (52-156 pounds).

(3) *Transfer pump operational check.* When engines are running, transfer pump operation must be checked by a method which does not depend on sound. Another factor is that transfer may be already underway when the pilot decides to conduct the transfer check. He cannot hear pumps running, and if transfer is in progress, the associated NO FUEL TRANSFER annunciator light will not flash, due to pressure within the transfer line. For fuel transfer pump operational check procedure, refer to chapter 8.

2-36. Ferry Fuel System.

CAUTION

Do not use AVGAS in the ferry fuel system. It has not been tested using AVGAS. Flow rates will be less, and consequently ferry fuel pump may not be able to keep up with engine demand.

a. *Description.* The ferry fuel system (fig. 2-15) provides additional fuel for ferry missions. The system consists of two removable fuel tanks, a removable ferry fuel control panel assembly, a permanently installed vent system and permanently installed interconnecting plumbing and wiring. A 15-ampere circuit breaker located on the lower wall behind the co-pilot's seat placarded FERRY SYSTEM POWER protects the ferry fuel system.

(1) *Ferry fuel tanks.* Two removable rectangular aluminum fuel tanks of 120 gallons (780 pounds) capacity each are bolted to the seat tracks in the cabin for ferry missions. A water sump and drain valve is provided at the lower aft end of each tank.

(a) *Ferry tank fuel gages.* One float actuated dial tyne fuel gage is provided on the forward end of the top side of each ferry fuel tank.

(b) *Ferry fuel tank shutoff valves.* A shutoff valve is located on the fuel line between each ferry fuel tank and the ferry fuel management panel.

(2) *Ferry fuel control panel assembly.* This unit is removed from the aircraft when the ferry fuel system is not required. It mounts to the seat tracks across the aisle directly aft of the pilot's and copilot's seats. It consists of two fuel switching

valves, two circuit-breaker switches, a fuel filter, and electric fuel pump, and a manual fuel pump.

(a) Manual fuel pump. If the electric fuel pump fails to operate, fuel may be pumped from the ferry fuel system tanks into the wing tanks by means of a manual fuel pump, located on the copilot's side of the fuel control panel assembly. When operated at 34 strokes per minute, the manual fuel pump will transfer 48 gallon/hour (315 pounds/hour) of fuel to the left wing and 48 gallon/hour (315 pounds/hour) of fuel to the right wing simultaneously (a total of 97 gallons/hour (630 pounds). The manual fuel pump will transfer 80 gallons/hour (520 pounds/hour) of fuel to one wing only. To maintain an equal fuel flow with engine consumption set at 200 pounds/hour, 22 strokes/minute are required.

(b) Ferry fuel selector valve. A four-position valve located on the ferry fuel control panel, placarded OFF, LEFT WING TANK, BOTH, RIGHT WING TANK, controls the flow of fuel from the ferry tanks.

(c) Electrical fuel pump and switch. Fuel is normally pumped from the ferry tanks by an electric fuel pump, located in the ferry system control panel assembly. It is controlled by a 7.5 ampere circuit-breaker switch, located on the ferry system fuel control panel, placarded FUEL PUMP, OFF, ON. The electric fuel pump will transfer 46 gallons/hour (300 pounds/hour) of fuel to the left wing and 46 gallon/hour (300 pounds/hour) of fuel to the right wing simultaneously (a total of 92 gallons (600 pounds/hour). The electric fuel pump will transfer 77 gallons/hour (500 pounds/hour) of fuel to one wing only.

(d.) Ferry system fuel vent heater switch. The ferry system fuel vent heater is controlled by a 7.5 ampere circuit-breaker switch located on the ferry system fuel control panel, placarded VENT HEAT, OFF, ON.

(e) Manual fuel pump control valve. A two position valve located on the ferry fuel control panel placarded FUEL SELECTOR - OFF, ON controls the flow of fuel through the ferry fuel system. Fuel cannot be pumped into the wing tanks by either the electric or manual pump unless this valve is in the ON position.

(f) Ferry system fuel filter. Fuel from the ferry tanks is pumped through a fuel filter located on the copilot side of the fuel system control panel assembly, placarded FUEL FILTER.

(3) Ferry fuel tank vent system. The ferry fuel tanks are connected to a heated fuel vent located on the underside of the aft fuselage. Secondary tank vents are installed on the top of each tank.

(4) Ferry system wheel well fuel shutoff valves. A fuel shutoff valve is installed on the ferry system fuel line in the forward section of each main wheel well. These valves must be open and secured with safety wire when the ferry system is being used.

NOTE

A safety of flight release is required for takeoff above maximum takeoff weight.

b. Normal Operation.

WARNING

Smoking in the aircraft is prohibited when the ferry system is installed.

WARNING

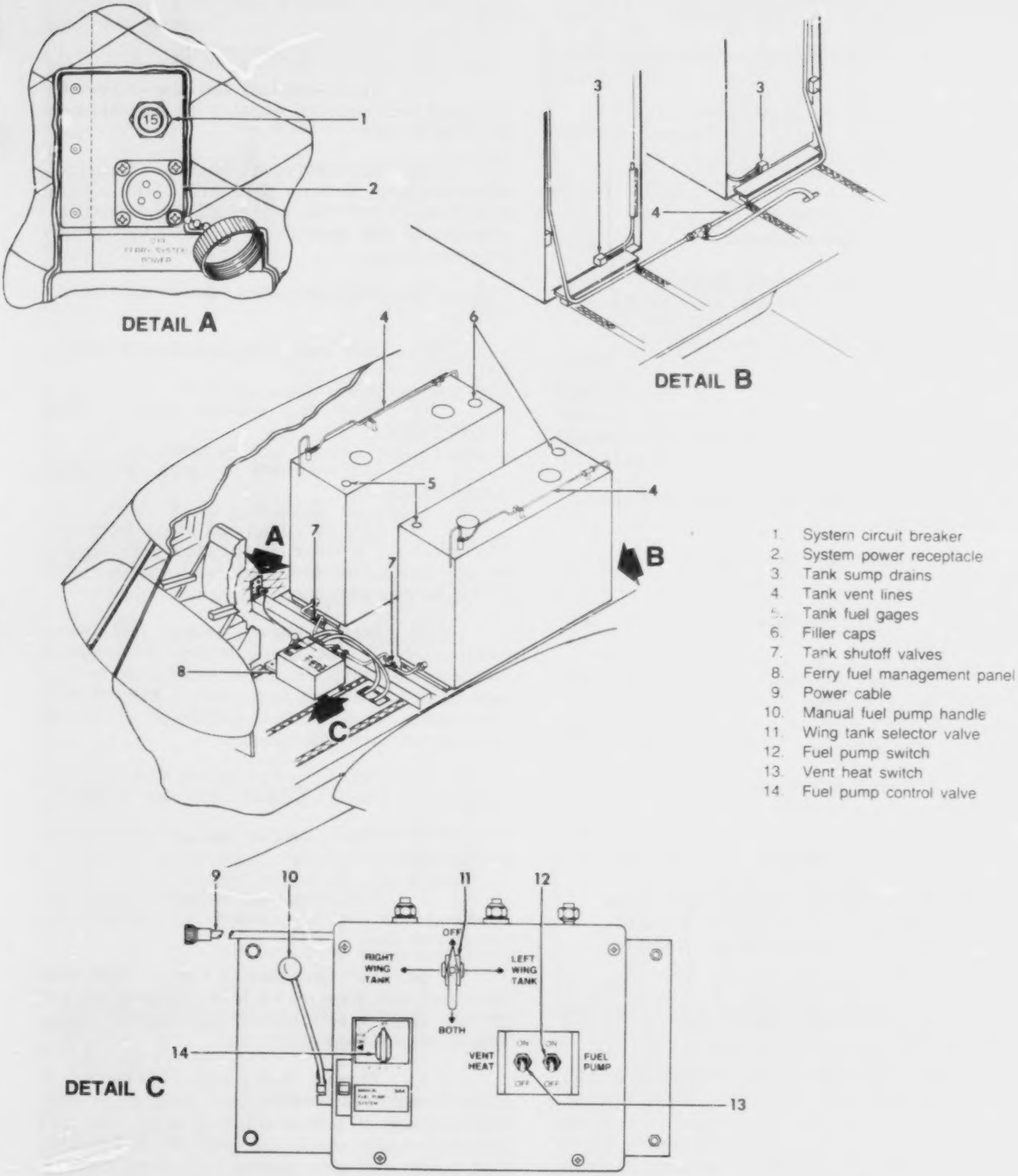
Continuing Continuing to pump fuel from the ferry tanks into the wing tanks after they are full will result in fuel being dumped overboard through the wing fuel tank vent system.

c. Preflight Functional Test.

NOTE

The aircraft's wing tanks should be nearly empty before beginning the ferry system preflight functional test. This will provide tank space for fuel transferred from the ferry tanks.

1. Ferry fuel tank shutoff valves (two, located between ferry tank outlet and ferry fuel control panel) - On.
2. Ferry fuel selector valve - OFF.
3. Manual fuel pump control valve - OFF.
4. Heated fuel vent switch - OFF.
5. Ferry system electric fuel pump switch - OFF.
6. Wing fuel drains - Closed.
7. Ferry tank water sumps (two) - Closed.


15
1
2
SYS
FERRY SYSTEM
POWER
DETAIL A
3
3
4
DETAIL B
4
6
5
4
A
7
7
B
8
C
9
10
11
12
OFF
RIGHT
WING
TANK
LEFT
WING
TANK
BOTH
14
VENT
HEAT
ON
ON
OFF
OFF
FUEL
PUMP
13
DETAIL C

1. System circuit breaker
2. System power receptacle
3. Tank sump drains
4. Tank vent lines
5. Tank fuel gages
6. Filler caps
7. Tank shutoff valves
8. Ferry fuel management panel
9. Power cable
10. Manual fuel pump handle
11. Wing tank selector valve
12. Fuel pump switch
13. Vent heat switch
14. Fuel pump control valve

Figure 2-15. Ferry Fuel System

8. Ferry system wheel-well fuel shutoff valves (two) - Check open and safetied.

9. Aircraft electrical equipment switches (all) - Off.

10. GPU - Connect.

11. Battery switch - ON.

WARNING

The battery switch may be left on to monitor fuel quantity gages and ferry fuel system electric pump, but must not be moved during fueling operations.

12. Ferry fuel tanks - Fill in accordance with fuel handling precautions and servicing instructions in Section XII, Servicing, Parking and Mooring.

13. Ferry system fuel lines and connectors - Check for leaks.

14. Left ferry fuel tank shutoff valve - Off.

15. Right wing tank fuel gage - Note indicated fuel quantity.

16. Right ferry tank fuel gage - Note indicated fuel level. Remove right ferry tank filler can and visually check that indicated fuel quantity corresponds to gage indication.

17. Manual fuel pump control valve - FUEL ON.

NOTE

The manual fuel pump control valve must be in the FUEL ON position to transfer fuel whether using the manual or electric fuel pump.

18. Ferry fuel selector valve - RIGHT WING TANK.

19. Ferry system electric fuel pump - ON. Transfer approximately 30 gallons of fuel (roughly one quarter of right ferry tank capacity) from the right ferry tank to the right wing tank system. Transfer of 30 gallons of fuel should take approximately 40 minutes.

20. Right ferry system fuel lines and connectors - Check the leaks while fuel is flowing.

21. Ferry system electric fuel pump - OFF.

22. Ferry fuel selector valve - OFF.

23. Right wing tank fuel gage - Check for increased indicated fuel quantity of approximately one quarter tank.

24. Right ferry tank fuel gage - Note indicated fuel level. Remove right ferry tank filler cap and visually check that gage reading approximately corresponds with quantity of fuel that has actually been transferred.

25. Right ferry fuel tank shutoff valve - OFF.

26. Left ferry fuel tank shutoff valve - ON.

27. Ferry fuel selector valve - LEFT WING TANK.

28. Left wing tank fuel gage - Note indicated fuel quantity.

29. Left ferry tank fuel gage - Note indicated fuel level. Remove left ferry tank filler cap and visually check that indicated fuel quantity corresponds to gage indication.

30. Ferry system electric fuel pump switch - ON. Transfer approximately 30 gallons of fuel (approximately one quarter of left ferry tank capacity) from the left ferry tank to the left wing tank system. Transfer of 30 gallons of fuel should take approximately 40 minutes.

31. Left ferry fuel system fuel lines and connectors - Check for leaks while fuel is flowing.

32. Ferry system electric fuel pump switch - OFF.

33. Left wing tank fuel gage - Check for increased indicated fuel quantity of approximately one quarter tank.

34. Left ferry tank fuel gage - Note indicated fuel level. Remove left ferry tank filler cap and visually check that indicated fuel quantity corresponds to gage indication.

35. Manual fuel pump - Operate at approximately 34 strokes per minute. Transfer approximately 10 gallons of fuel in to left wing tank system. Visually check fuel level inside left ferry tank before and after manual fuel pump check to insure that fuel actually had been transferred.

36. Wing tank fuel gages (2) - Note indicated fuel quantity.

37. Ferry tank fuel gages (2) - Note indicated fuel quantity.

38. Right ferry fuel tank shutoff valve - ON.

39. Ferry fuel selector valve - BOTH.

40. Ferry system electric fuel pump - ON. Transfer approximately 60 gallons of fuel (approximately one quarter of the capacity of both ferry tanks). Transfer of 60 gallons of fuel should take approximately 40 minutes.

41. Ferry system electric fuel pump - OFF.

42. Ferry fuel selector valve - OFF.

43. Ferry fuel tank shutoff valves (2) - On.

44. Manual fuel pump control valve - OFF.

45. Ferry fuel system vent heat switch - ON. Check that temperature of heated vent increase then turn switch OFF.

46. Battery switch - OFF.

47. GPU - Disconnect as required.

48. Ferry fuel tanks - Fill in accordance with fuel handling precautions and servicing instructions in Section XII, Servicing,, Parking and Mooring.

NOTE

Settling time for jet fuels is one hour per foot of tank depth. Allow the fuel to settle for the prescribed period of time before any fuel samples are taken.

49. Fuel sample - Take from each ferry tank drain.

50. Ferry fuel tank fuel and caps - Check fuel level visually. Check seal is installed, cap is tight and properly installed.

(d) Before Takeoff. Heated fuel vent switch - ON

(e) During Flight.

1. Wing fuel gages - Monitor (until wing tanks are 1/2 to 3/4 full).

2. Ferry system fuel selector valve - LEFT WING TANK, BOTH, or RIGHT WING TANK as required.

3. Manual fuel pump selector valve - ON.

4. Ferry system electric fuel pump switch - ON.

5. Wing fuel gages - Monitor (until wing tanks are almost full).

6. Ferry system electric fuel pump switch - OFF.

7. Manual fuel pump selector valve - OFF.

8. Steps 1-7 - Repeat as required until ferry fuel tanks are empty.

f. Emergency Operation. If the ferry system electric fuel pump should fail to operate, follow the procedure outlined below.

1. Ferry system fuel selector valve - LEFT WING TANK, BOTH, or RIGHT WING TANK as required.

2. Manual fuel pump selector valve - ON.

3. Manual fuel pump handle - Pump as required.

NOTE

Fuel will not gravity feed from the ferry tanks to the wing tanks.

2-37. Approved Fuels.

CAUTION

The use of aviation gasoline is time-limited to 150 hours of operation during any Time-Between-Overhaul (TBO) period. It may be in any quantity with aviation kerosene.

CAUTION

Do not use AVGAS in the ferry fuel system. It has not been tested using AVGAS. Flow rates will be less, and consequently ferry fuel pump may not keep up with engine demand.

The aircraft may use JP-4 or JP-5 in any ratio. Civilian jet fuel may not contain an anti-ice/fungicide and may thicken when temperatures drop below -40°F. In the event aviation kerosene is not available, aviation gasoline is an approved emergency fuel. Refer to Section XII, Servicing, Parking and Mooring.

NOTE

Aviation gasoline (AVGAS) contains a form of lead which has an accumulative adverse effect on gas turbine engines. The lowest octane AVGAS available (less lead content) shall be used. If more than 10% of the total fuel on board is AVGAS, the total operating time shall be entered in DA Form 2408-13.

SECTION V. FLIGHT CONTROLS

2-38. Description.

The aircraft's primary flight control system consists of rudder, elevator and aileron control surfaces. These surfaces are manually operated from the cockpit through mechanical linkage using control wheels for the ailerons and elevators, and adjustable rudder/brake pedals for the rudder. Trim control for the rudder, elevator and ailerons is accomplished through a manually actuated cable-drum system for each set of control surfaces.

2-39. Control Wheels.

Elevator and aileron control surfaces are operated by manually actuating either the pilot's or copilot's control wheel (fig. 2-5). Electric switches are installed in the outboard grip of each wheel to operate the elevator trim tabs, to disengage the autopilot/yaw damp, control wheel steering, and press-to-talk microphone switch. These control wheels (fig. 2-16) are installed on each side of the instrument subpanel. An electric digital clock is installed in the center of each wheel.

2-40. Rudder Pedals.

Aircraft rudder control and nose wheel steering is accomplished by actuation of the rudder pedals from either pilot's or copilot's station (fig. 2-5). A fore and aft position adjustment of the pedals is provided through an adjustment control lever on each pedal. For toe brake coverage refer to paragraph 2-8.

2-41. Flight Controls Lock.

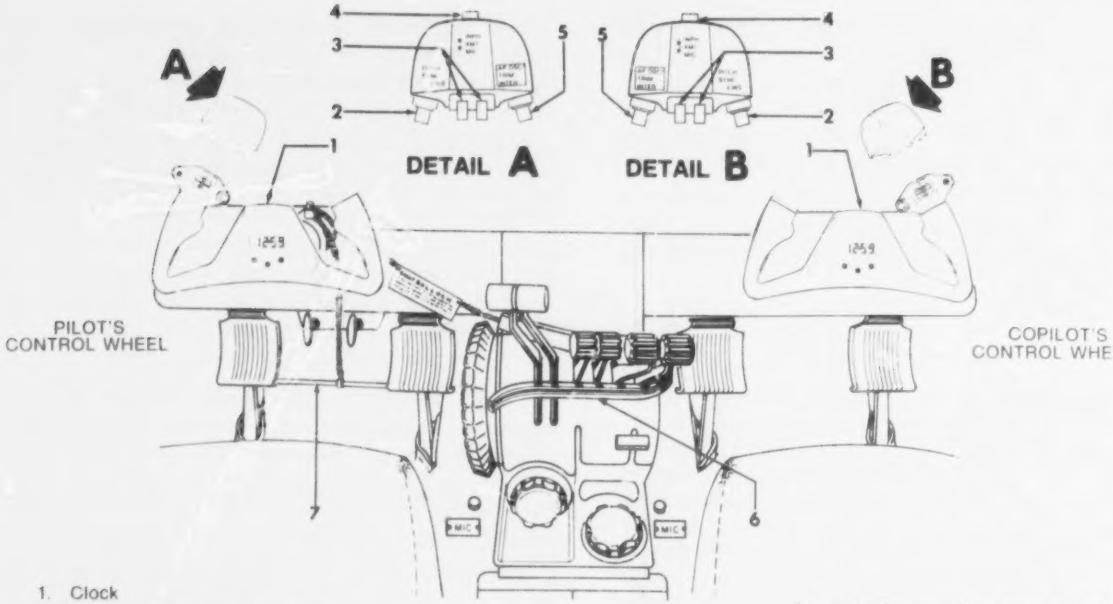
Positive locking of the rudder, elevator and aileron control surfaces, and engine controls (power levers, propeller levers, and condition levers) is provided by a removable lock assembly consisting of two pins and an elongated U-shaped strap interconnected by a chain (fig. 2-16). Installation of the control locks is accomplished by inserting the strap over the aligned engine control levers from the copilot's side; then the aileron-elevator locking pin is inserted through a guide hole in the top of the pilot's control column assembly, thus locking the control wheels. The rudder pedals are held in the neutral position by the largest of the two pins, which is installed horizontally through the pilot's rudder pedals. Removal sequence is a reverse of the installation procedure.

2-42. Trim Tabs.

Trim tabs are provided for all flight control surfaces. These tabs are manually actuated, and are mechanically controlled by a cable-drum and jackscrew actuator system. Elevator and aileron trim tabs incorporate anti-servo action, i.e., as the elevators or ailerons are displayed from the neutral position, the trim tab moves in the same direction as the applied control surface, thus increasing the effective control surface area and the manual force required to apply it. This action increases control pressure. The rudder trim tab is adjustable left or right as required and maintains an "as adjusted" position through out the full range of rudder deflection.

a. Elevator Trim Tab Control The elevator trim tab control wheel placarded ELEVATOR TAB - DOWN, UP, is on the left side of the control pedestal and controls a trim tab on each elevator (fig. 2-6). The amount of elevator tab deflection, in degrees from a neutral setting, is indicated by a position arrow.

b. Electric Elevator Trim. The electric elevator trim system is controlled by dual element thumb switches on the control wheels, a trim disconnect switch on each control wheel, and a circuit breaker located on the control pedestal. The dual element thumb switch is moved forward for trimming nose down, and aft for nose up. When released, the switch returns to the center (off) position. Any activation of the trim system through the copilot's trim switch will be over-ridden by activation of the pilot's switch. A preflight check of the dual element switches should be accomplished before flight by moving the switches individually on both control wheels. No one switch alone should operate the system; operation of elevator trim should occur only by movement of pairs of switches. The trim system disconnect is a bi-level, pushbutton, momentary type



1. Clock
2. Control wheel steering switch
3. Electric trim switches
4. Microphone switch
5. Autopilot/yaw damp/trim switch
6. Engine controls lock bar
7. Rudder lock pin

Figure 2-16. Control Wheels and Control Locks

switch, located on each control wheel. Depressing the switch to the first of two levels disconnects the autopilot and yaw damp system, and the second level disconnects the electric trim system. The manual trim system cannot be used simultaneously.

c. Aileron Trim Tab Control. The aileron trim tab control, placarded AILERON TAB - LEFT, RIGHT, is on the control pedestal and will adjust the left aileron trim tab only (fig. 2-6). The amount of aileron tab deflection, from a neutral setting, as indicated by a position arrow, is relative only and is not in degrees. Full travel of the tab control moves the trim tab 7-1/2 degrees up and down.

d. Rudder Trim Tab Control. The rudder trim tab control knob, placarded RUDDER TAB - LEFT, RIGHT, is on the control pedestal, and controls adjustment of the rudder trim tab (fig. 2-6). The amount of rudder tab deflection, in degrees from a neutral setting, is indicated by a position arrow.

2-43. Wing Flaps.

The all-metal slot-type wing flaps are electrically operated and consist of two sections for each wing. These sections extend from the inboard end of each aileron to the junction of the wing and fuselage. During extension, or retraction, the flaps are operated as a single unit, each section being actuated by a separate jackscrew actuator. The actuators are driven through flexible shafts by a single, reversible electric motor. Wing flap movement, either up or down, is indicated in percent of travel by a flap position indicator on the center of the control pedestal. Full flap extension and retraction time is approximately 11 seconds. The flap control switch is also located on the control pedestal. No emergency wing flap actuation system is provided. The circuit is protected by a 20-ampere push-pull circuit breaker, placarded FLAP MOTOR POWER, located on the copilot's circuit breaker panel (fig. 2-18).

a. Wing Flap Control Switch. Flap operation is controlled by a three-position switch with a flap-shaped handle on the control pedestal (fig. 2-6). The handle of this switch is placarded FLAP and switch positions are placarded: FLAP - UP, APPROACH, and DOWN. The amount of downward extension of the flaps is established by position of the flap switch and is as follows: UP - 0%, APPROACH - 35%, and DOWN - 100%. Limit switches, mounted on the right inboard flap, control flap travel. The flap control switch, limit switch, and relay circuits are protected by a 5-ampere circuit breaker, placarded FLAP IND, locate on the right subpanel (fig. 2-7). Flap positions between UP and APPROACH cannot be selected. For intermediate flap positions between APPROACH and DOWN the APPROACH position acts as an off position. To return the flaps to any position between full DOWN and APPROACH, place the flap switch to UP and when desired flap position is obtained, return the switch to the APPROACH detent.

b. Wing Flap Position Indicator. Flap position in percent of travel from 0 percent (UP) to 100 percent (DOWN), is shown on an indicator, placarded FLAPS on the control pedestal (fig. 2-6). The approach and full down or extended flap position is 15 and 43 degrees, respectively. The flap position indicator is protected by a 5-ampere circuit breaker, placarded FLAP IND, located on the right subpanel (fig. 2-7).

SECTION VI. PROPELLERS

2-44. Description.

A three-bladed aluminum propeller is installed on each engine. These propellers are hydraulically controlled, constant-speed full-feathering and reversible. Each propeller is controlled by engine oil acting through an engine-driven propeller governor. Feathering is accomplished by the feathering springs assisted by centrifugal force applied to the blade shank counterweights. Governor boosted engine oil pressure moves the propeller blades to the high RPM (low pitch) hydraulic stop and into reverse pitch. Low pitch propeller position is determined by a mechanically monitored hydraulic stop. A back-up system, referred to as the secondary low pitch stop, protects against propeller reversing in the event of failure of the primary hydraulic low pitch stop system. In the event of loss of oil pressure, the propeller blades will go to the feathered position.

2-45 Feathering Provisions.

The aircraft is equipped with both manual and automatic propeller feathering. Manual feathering is accomplished by pulling the corresponding propeller lever aft past a friction detent. To unfeather, the propeller lever is pushed forward into the governing range. An automatic feathering system, if armed, will sense loss of torque oil pressure and will feather an unpowered propeller. Feathering springs will feather the propeller when it is not turning.

a. Automatic Feathering. Automatic feathering can occur only when the PROP AUTOFEATHER Switch is in the ARM position, both power levers are above 88 to 92% N_1 and the torque value of one engine drops below 160 to 290 ft-lbs. The autofeather system has a cross-interlocking safety feature designed into the control circuit to prevent automatic feathering of both propellers. Before a propeller feathers automatically, the interlock disarms the autofeather circuit of the opposite propeller. After autofeathering has occurred for one propeller the opposite propeller can be feathered only by the manual control.

b. Propeller Autofeather Switch. Autofeathering is controlled by a PROP AUTOFEATHER switch on the left subpanel (fig. 2-7). The three-position switch is placarded ARM, OFF and TEST, and is spring-loaded from TEST to OFF. The ARM position is used only during takeoff and landing. At ARM, if an engine loses power above 88% to 92% N_1, two torque-sensing switches of the affected engine are actuated by loss of torque pressure. Switch actuation applies current through an autofeather relay to a corresponding dump valve, causing the release of oil pressure which held an established pitch angle on the blades of the affected propeller. Following the release of oil pressure, feathering movement is accomplished by the feathering springs assisted by centrifugal force applied to the blade shank counterweights. The TEST position of the switch, enable the pilot to check readiness of the autofeather systems, below 88 to 92% N_1, and is for ground checkout purposes only. Refer to chapter 8.

c. Autofeather Lights. Two amber lights on the instrument panel, placarded AUTOFEATHER LEFT and RIGHT, when illuminated indicate that the autofeather system is armed (fig. 2-22). Both light will be extinguished if either propeller has been autofeathered or if the system is disarmed by retarding a power lever. Both lights may be dimmed by rotating the cover. Autofeather circuits are protected by one 5-ampere circuit breaker placarded PROP FEATHER, located on the right subpanel (fig. 2-18).

2-46. Propeller Governors.

Each propeller system utilizes three governors, one "primary" and two "backup", to control propeller RPM. Each propeller lever establishes RPM for the respective propeller by altering the setting of a primary governor attached to the engine gear reduction housing. It is the primary governor which controls RPM through the entire range. Should a primary governor malfunction (exceeding 2200 RPM) an overspeed governor cuts-in (2248 to 2328 RPM), dumping oil from the propeller to prevent RPM from exceeding safe limits. A solenoid actuated by the PROP GOV TEST switch enables the overspeed governor to be reset for test purposes (1980 to 2060 RPM). If a propeller should stick or move too slowly during a transient condition, the corresponding governor would be unable to prevent an overspeed condition. To provide for this contingency, the engine power turbine governor acts as a fuel topping governor. Thus, when the propeller RPM reaches 2332 RPM, this governor limits the fuel flow into the engine thereby reducing the power driving the propeller. During propeller operation in the reverse range, the engine power turbine governor will automatically be reset to allow a maximum of 2040 RPM.

2-47. Propeller Governor Test Switches.

Two, three-position switches on the left subpanel, are provided for operational test of the propeller systems (fig. 2-7). The switches are placarded PROP GOV TEST, LEFT, RIGHT (above) and SECONDARY IDLE STOP TEST (below). Each switch is a double unit, controlling two different test circuits for the corresponding propeller. In up position, the switches are used to test the function of the corresponding overspeed governor. In the down position, the switches are used to test function of the corresponding secondary low pitch stop. Each switch is spring-loaded to the OFF (center) position. Refer to chapter 8, for steps of both test procedures. Propeller test circuits are protected by one 5-ampere circuit breaker, placarded PROP GOV IDLE STOP, located on the right subpanel (fig. 2-7).

2-48. Propeller Levers.

Two propeller levers on the control pedestal, placarded PROP, are used to regulate propeller speeds (fig. 2-6). Each lever controls a primary governor, which acts to regulate propeller speeds within the normal operating range. The full levers forward position is placarded TAKEOFF, LANDING AND REVERSE, and also HIGH RPM. Full levers aft position is placarded FEATHER. When a lever is placed at HIGH RPM, the propeller may attain a static RPM of 2200, depending upon power lever position. As a lever is moved aft, passing through the propeller governing range, but stopping at the feathering detent, propeller RPM will correspondingly decrease to the lowest limit. Moving a propeller lever aft past the detent into FEATHER will feather the propeller.

2-49. Propeller Reversing.

CAUTION

Moving the power levers into reverse range without the engine running will result in damage to the reverse linkage mechanisms.

CAUTION

To prevent damage to reversing linkage and an assymmetric thrust condition, propeller levers must be in HIGH RPM position prior to propeller reversing.

The propeller blade angel may be reversed to shorten landing roll. To reverse, propeller levers are positioned at HIGH RPM (full forward), and the power levers are lifted up to pass over an IDLE detent, then pulled aft into REVERSE setting. In REVERSE position, each power lever overrides the corresponding secondary idle stop, allowing engine power for the beta add reverse ranges. Power levers must be pulled back through normal idle speed range before being positioned in REVERSE.

a. Propeller Reverse Not-Ready Annunciator Light. One yellow caution light, placarded REVS NOT READY, on the caution annunciator panel alerts the pilot not to reverse the propellers (fig. 2-22). This light illuminates only when the landing gear handle is down and if propeller levers are not at HIGH RPM (full forward). This circuit is protected by a 5-ampere circuit breaker, placarded LDG GR CONTROL, located on the right subpanel (fig. 2-18).

b. Propeller Primary Pitch Annunciator Lights. Two yellow lights placarded L PRI PITCH and R PRI PITCH are located on the caution annunciator panel (fig. 2-22). Illumination of a light indicates malfunction of the normal propeller low-pitch stop, and that the secondary low pitch functions for the affected propeller. Propeller reverse pitch operation must not be attempted while either of these lights are illuminated. Refer to chapter 9.

2-50. Propeller Tachometers.

Two tachometers on the instrument panel register propeller speed in hundreds of RPM (fig. 2-22). Each indicator is slaved to a tachometer generator unit attached to the corresponding engine.

SECTION VII. UTILITY SYSTEMS

2-51. Defrosting System.

a. Description. The defrosting system is an integral part of the heating and ventilation system. The system consists of two warm air outlets connected by ducts to the heating system. One outlet is just below the pilot's windshield and the other is below the copilot's windshield. A push-pull control, placarded DEFROST AIR, on the right subpanel (fig. 2-7), manually controls airflow to the windshield. When pulled out, defrosting air is ducted to the windshield. As the control is pushed in, there is a corresponding decrease in airflow.

b. Normal Operation

1. Vent blower operation - Check.
2. HTR switch - AUTO.
3. CABIN TEMP control - As required.
4. CABIN AIR, VENT AIR, and DEFROST AIR controls - As required.

NOTE

For maximum windshield defrosting, pull out the CABIN AIR, VENT AIR, and DEFROST AIR controls and position the HTR switch to MAN. Regulate the temperature by opening one or more of the cold air outlets.

c. Emergency Operation. If the automatic temperature control should fail to operate, the temperature (of defrost air and cabin air) may be controlled manually by manipulating the HTR control switch between the OFF and MAN positions.

2-52. Surface Deicer System.

a. Description. Ice accumulation is removed from each outboard wig leading edge, both horizontal stabilizers, and the vertical stabilizer by the flexing of deicer boots which are pneumatically actuated. Engine bleed air, from the engine compressor, is used to supply air pressure to inflate the deicer boots, and to supply vacuum, through the ejector system, for boot hold down during flight. A pressure regulator protects the system from over-inflation. When the system is not in operation, a distributor valve applies vacuum to the boots for hold-down. When a solenoid in the distributor valve is energized by the pneumatic deicer timer, or when either the surface or antenna DEICE CYCLE switch is positioned to MNL (manual), a servo valve changes the inlet to the boots from vacuum to pressure which allows the boots to inflate. When the solenoid valve is de-energized, the airflow through the valve is cutoff. The air then discharges out of the boots through an integral check valve until the pressure reaches approximately 1 in Hg, at which time the boots are ported to vacuum and the remaining air is evacuated. The boots are again held down by vacuum.

1. Either engine is capable of providing sufficient bleed air for all requirements of the surface deicer system. Check valves in the bleed air and vacuum lines prevent backflow through the system during single-engine operation. Bleed air passes through a 16 PSI regulator and then enters the deicer and vacuum systems. Vacuum pressure is created by the ejector and is proportional to pneumatic pressure supplied by the deicer pressure regulator valve. Regulated pressure is indicated on a gage, placarded PNEUMATIC PRESSURE, located on the control pedestal (fig. 2-6).
2. The operation of the surface deicer system is controlled by a three-position switch located on the left subpanel. The switch is placarded DEICE CYCLE, SINGLE, OFF, MANUAL. The surface deicer system is protected by two 5-ampere circuit breakers, placarded SURF DEICE located on the right subpanel.

b. Normal Operation.

1. Deice boots are intended to remove ice after it has formed rather than prevent its formation. For the most effective deicing operation, allow at least 1/2 inch of ice on the boots to accumulate before attempting ice removal. Very thin ice may crack and cling to the boots instead of shedding.

NOTE

Never cycle the system rapidly, since this may cause the ice to accumulate outside the contour of the inflated boots and prevent ice removal.

2. Normal operation of the surface deice system is accomplished by use of the three-position switch, located on the left subpanel, placarded DEICE

CYCLE, SINGLE, OFF, MANUAL. SINGLE and MANUAL positions are momentary. The switch returns to the center, OFF position, when the toggle is released. When switched to the SINGLE position, the deicer boots automatically inflate for seven to eight seconds, then deflate and return to the vacuum hold down position. In MANUAL position, all boots inflate and stay inflated while the switch is in this mode. When the switch is released, all boots deflate and the toggle returns to the center OFF position. The MANUAL position is for use in case of timer failure. In either switch position, the boots cannot be over-inflated.

2-53. Propeller Electrothermal Deicer System.

a. Description. Electrothermal deicer boots are cemented to each propeller blade to prevent ice formation or to remove ice from the propellers. Each thermal boot consists of one outboard and one inboard heating element, and receives electrical power from the deicer timer. This timer sends current to all propeller thermal boots and prevents the deicers from overheating by limiting the time each element is energized. Four intervals of approximately 3 seconds each complete one cycle. Current consumption is monitored by a PROP AMMETER on the left subpanel (fig. 2-7). A 20-ampere circuit breaker switch, placarded PROP, on the left subpanel (fig. 2-18), controls the propeller electrothermal deicer system.

b. Normal Operation. Operation of the propeller deicing system is controlled by the propeller heat switch, placarded PROP, which controls two inboard and outboard, heating elements in each propeller boot. When ice formation becomes visible on the aircraft, or when ice is expected, place this switch in the HEAT position. The timer will then cycle power to the heating elements. The timer successively delivers current to the outer heaters on one propeller, the inner heaters on the same propeller, the outer heaters on the opposite propeller and the inner heaters on the same propeller. The timer energizes each of these four phases in turn for about 30 seconds and then repeats the cycle as long as the control switch is on. When the timer shuts off, it advances one cycle. Each cycle is 30 seconds in duration, which makes a complete cycle lasting two minutes. When the timer switches from one phase to the next, the ammeter will register a momentary deflection. These fluctuations inform the pilot that the timer is switching properly.

NOTE

On aircraft equipped with electronic timers, cycle switching occurs very rapidly and may or may not be detectable as a flicker of the ammeter needle. These timers cannot be manually stepped through cycles by alternately energizing and deenergizing the system on/off switch.

Heating may begin at any phase in the cycle depending on the timer position when the switch was turned off from previous use. If ammeter readings are above or below the operating limits, propeller unbalance may occur when operating in icing conditions.

2-54. Pitot and Static System.

a. Description. The pitot and static system supplies static pressure to two airspeed indicators, two altimeters, two vertical velocity indicators, and ram air to the airspeed indicators. This system consists of a single pitot tube attached to the underside of the left wing leading edge, static air pressure ports in the aircraft's exterior skin on each side of the aft fuselage, and associated system plumbing. The pitot head is protected from ice formation by internal electrical heating elements. Refer to Pitot and Stall Warning Heat System, Section VIII.

b. Emergency Static Air Source. A knob type control valve located at the upper right corner of the instrument panel permits the selection of an alternate static air pressure source. It is placarded EMERGENCY STATIC AIR SOURCE, NORM OFF. The normal operating position (NORMAL, OFF) supplies static air pressure from the external pressure ports on the aft fuselage. When required, static pressure may be obtained from the alternate source by rotating the control knob counterclockwise. For airspeed calibration, when using the emergency static air source, refer to chapter 7.

2-55. Pitot and Stall Warning Heat System.

CAUTION

Pitot and stall warning heat should not be used for more than 15 minutes while the aircraft is on the ground. Overheating may damage the heating elements.

a. Description. The pitot tube and stall warning vane have electrical heating elements to prevent icing. Both heating elements are controlled by the same 10-ampere, circuit-breaker type switch, located on the left subpanel, placarded HEAT, LH PITOT (fig. 2-7).

b. Normal Operation. When the pitot heat switch is in the LH (up) position, the heating element in the exposed portion of the pitot tube is energized. The OFF (down) position shuts the pitot and stall warning vane heating elements off. In the event of overload, the circuit breaker element of the switch will disconnect the heating circuits, tripping the switch toggle to the OFF (down) position. To reset power to the heating circuits move the toggle switch to the HEAT (up) position.

2-56. Fuel System Anti-Icing.

a. Description. An oil-to-fuel heat exchanger, located on each engine accessory case, operates continuously and automatically to heat the fuel sufficiently to prevent freezing of any water in the fuel. No controls are involved. One external fuel vent on each wing serves both the nacelle and wing tanks and is protected against icing by externally attached electric heat element, controlled by the 5-ampere circuit breaker toggle switches on the left subpanel, placarded HEAT - FUEL VENTS-LEFT, and the 7.5 ampere circuit breaker switch placarded HEAT-FUEL VENTS-RIGHT (fig. 2-7).

CAUTION

To prevent overheat damage to electrically heated anti-ice jackets, FUEL VENT HEAT switches should not be turned ON unless cooling air will soon pass over the jackets.

b. Normal Operation. For normal operation, HEAT switches for the FUEL VENTS anti-ice circuits are turned ON as required during the BEFORE TAKEOFF procedures. FUEL CONTROL HEAT switches are turned ON during the STARTING ENGINES procedures. Refer to chapter 8.

2-57. Windshield Electrothermal Anti-Ice Systems.

a. Description. Both pilot and copilot windshields are provided with an independent electrothermal anti-ice system. Each system is comprised of the windshield assembly with heating wires and sandwiched between glass panels, a temperature sensor attached to the glass, an electrothermal controller, a relay switch, and a control switch. Both ON-OFF control switches, placarded WSHLD ANTI-ICE - PILOT, COPILOT, are located on the left subpanel (fig. 2-7). Each switch controls one electrothermal windshield system. The circuits of each system are protected by a respective 1/2-ampere circuit breaker and a respective 25-ampere circuit breaker on the right subpanel, placarded WINDSHIELD ANTI-ICE - PILOT, COPILOT (fig. 2-7).

b. Normal Operation. Each electrothermal windshield is activated by placing the corresponding WINDSHIELD ANTI-ICE switch to the ON position. If glass temperature is below 43°C, the electrothermal controller will actuate a relay switch applying power to the heating wires sandwiched within the glass. A windshield will warn to a maximum of 43°C and then will cycle off. It will recycle ON again when the glass temperature drops 2.5°C below cutoff. Refer to chapter 8.

2-58. Oxygen System.

a. Description Occupants will receive oxygen from a supply system which has a capacity which ranges from 11 cu ft to 203 cu ft, depending upon the combination of supply cylinders which are coupled into provisions of the aircraft. Figure 2-17 shows the location of the cylinders, one of which may be located in the left nose compartment below the avionics equipment, and some may be located aft of the main entrance door in the cabin. All cylinders are interconnected, using check valves, so that refilling of all cylinders can be accomplished through a single filler valve located in the cabin adjacent to the 11-cu ft cylinder. Each cylinder has a pressure gage. The oxygen system pressure gage, placarded OXYGEN SUPPLY PRESSURE, is located aft of the fuel management panel. This gage shows the amount of pressure remaining in the oxygen supply cylinders. Table 2-2 shows oxygen duration capacities of the system for all crew and passenger combinations. Supply lines from the cylinders are routed to two high pressure, slow-release supply valves located below the fuel management panel. Each oxygen supply valve has a flow governing feature controlled by an integral pressure differential sensor. When initially turned ON by the pilot, only a small flow is allowed to meter into the line. Flow restriction continues until the pressure levels are equalized, at which time the valve opens up completely, permitting a full flow condition. The forward valve (fig. 2-17), placarded CREW OXYGEN, controls high pressure flow to a pressure reducer located on the forward cabin wall behind the instrument panel. This reducer lowers pressure to a 300 to 400 PSI range and routes oxygen to the regulator control panels for the pilot and copilot. The pilot's and copilot's regulators are of the diluter demand type. That is, when in the NORMAL OXYGEN mode the regulator mixes the proper amount of oxygen for a given amount of air at flight altitude. The aft slow-release valve, placarded CABIN OXYGEN, controls supply to the cabin oxygen regulators, which provides passenger-regulated 100% oxygen to the passenger oxygen outlets. A plug-in type valve at each of six stations above the seat positions deliver oxygen for passenger use. The 100% oxygen flows continuously to passengers, when the masks are coupled into an oxygen outlet.

(1) Regulator control panels. The pilot's oxygen regulator control panel is located on the cockpit sidewall below the fuel management panel. The copilot's oxygen regulator control panel is located on the cockpit sidewall below the copilot's circuit breaker panel. Each panel contains a blinker-type flow indicator, a 2000 PSI gage, a red emergency pressure control lever placarded: EMERGENCY-NORMAL-TEST MASK, a white diluter control lever placarded 100% OXYGEN and NORMAL OXYGEN, and a green supply control lever placarded ON/OFF. The supply control lever turns the individual regulator ON and OFF. The diluter control lever gives the selection of either normal of 100% oxygen but acts to select only when the emergency pressure control lever is placed in NORMAL position.

CAUTION

When not in use, the diluter control lever should be left in the 100% OXYGEN position to prevent regulator contamination.

(a) The emergency pressure control lever has three positions - two positions control oxygen consumption for the individual using oxygen, and the remaining position serves for testing hose and mask integrity. In the EMERGENCY position, the control lever causes 100% oxygen to be delivered at a safe, positive pressure. In NORMAL position, the lever allows delivery of normal or 100% oxygen depending upon the selection of diluter control lever. In TEST MASK position 100% oxygen at positive pressure is delivered to check hose and mask integrity.

(b) The 2000 PSI oxygen pressure gage provided on the oxygen control panels should at no time indicate over 400 PSI. If the pressure exceeds 400 PSI, a malfunction of the pressure reducer is indicated. Whenever oxygen is inhaled, a blinker-vane slides into view within the flow indicator window, showing that oxygen is being released. When oxygen is exhaled, the blinker-vane vanishes from view.

NOTE

Check to insure that the OXYGEN SUPPLY PRESSURE gage registers adequate pressure before each flight. A check of the supply pressure should be made at intervals during flight to note the quantity available and to approximate the supply duration. The outside temperature is reduced as an aircraft ascends to higher altitudes. Oxygen cylinders thus cooled by temperature change will show a pressure drop. This type of drop in pressure will raise again upon return to a lower or warmer altitude. A valid cause for alarm would be the rapid loss of oxygen pressure when the aircraft is in level flight or descending; should this condition arise, descend as rapidly as possible to an altitude which does not require the use of oxygen.

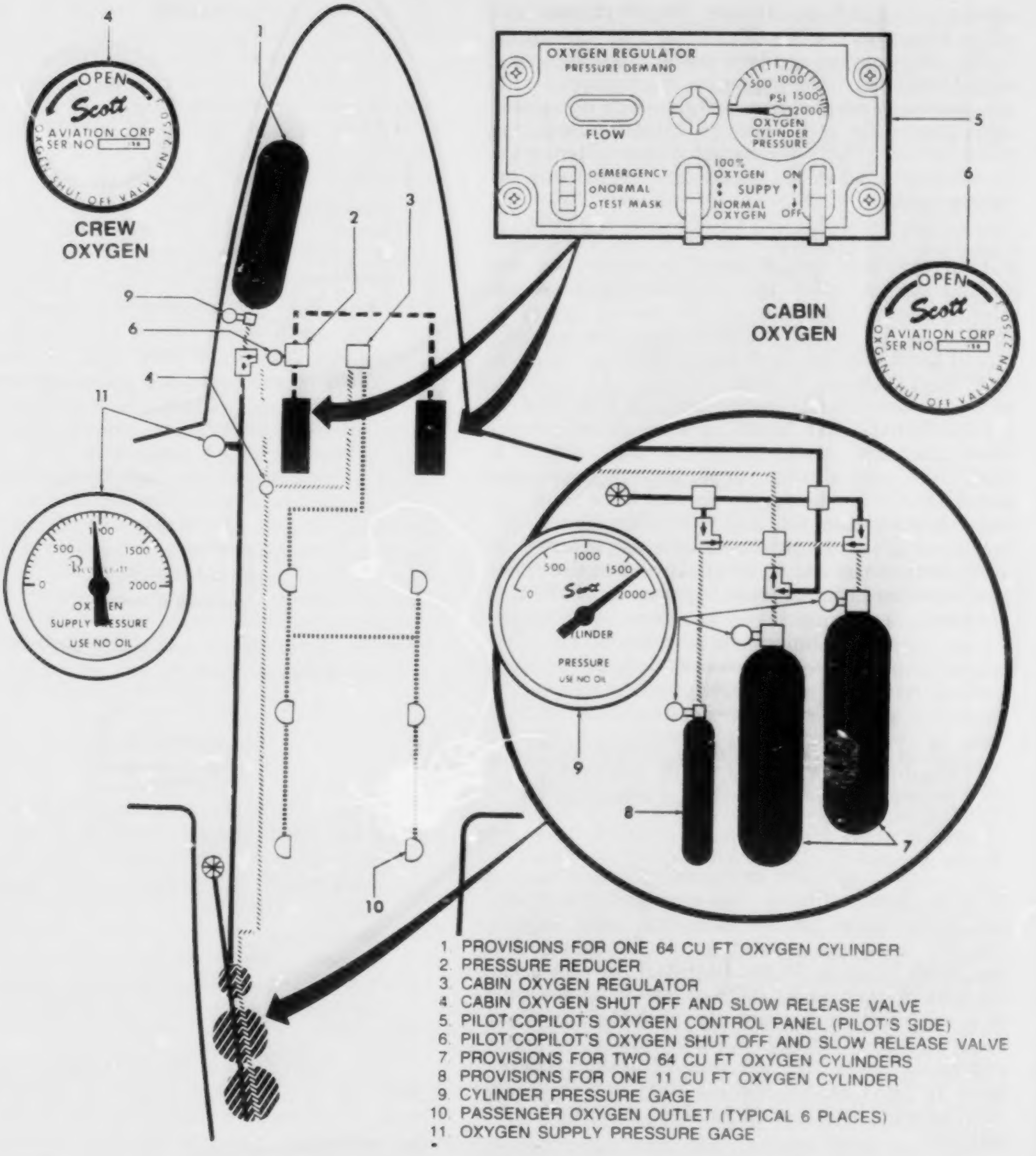
WARNING

Pure oxygen will support combustion. Do not smoke while oxygen is in use.

WARNING

If any symptoms occur suggestive of the onset of hypoxia, immediately set the emergency pressure control lever to the EMERGENCY position and descend below 10,000 feet. Whenever carbon monoxide or the noxious gas is present or suspected, set the diluter control lever to 100% OXYGEN and continue breathing undiluted oxygen until the danger is past.

(2) Oxygen masks. Oxygen masks for the pilot and copilot are provided as personal equipment. To connect a mask into the oxygen system, the individual connects the line attached to the mask to the flexible hose which is attached to the cockpit sidewall. The microphone in the oxygen mask is provided with a cord for connecting with the helmet microphone jack. To test mask and hose integrity, the CREW OXYGEN shut-off valve is turned on, then the individual places the supply control lever on the regulator control panel to the ON position, dons and adjusts his mask, selects TEST MASK position, and checks for leaks.


4
OPEN
Scott
AVIATION CORP
SER NO
OXYGEN SHUT OFF VALVE PN 2750
CREW OXYGEN
1
2
3
OXYGEN REGULATOR
PRESSURE DEMAND
FLOW
500 1000 PSI 1500 2000
OXYGEN CYLINDER PRESSURE
EMERGENCY
NORMAL
TEST MASK
100% OXYGEN
SUPPY
NORMAL OXYGEN
ON
OFF
5
6
CABIN OXYGEN
9
6
4
11
0 500 1000 1500 2000
OXYGEN SUPPLY PRESSURE
USE NO OIL
0 500 1000 1500 2000
Scott
CYLINDER PRESSURE
USE NO OIL
9
8
7
10

1. PROVISIONS FOR ONE 64 CU FT OXYGEN CYLINDER
2. PRESSURE REDUCER
3. CABIN OXYGEN REGULATOR
4. CABIN OXYGEN SHUT OFF AND SLOW RELEASE VALVE
5. PILOT COPILOT'S OXYGEN CONTROL PANEL (PILOT'S SIDE)
6. PILOT COPILOT'S OXYGEN SHUT OFF AND SLOW RELEASE VALVE
7. PROVISIONS FOR TWO 64 CU FT OXYGEN CYLINDERS
8. PROVISIONS FOR ONE 11 CU FT OXYGEN CYLINDER
9. CYLINDER PRESSURE GAGE
10. PASSENGER OXYGEN OUTLET (TYPICAL 6 PLACES)
11. OXYGEN SUPPLY PRESSURE GAGE

LEGEND

▬	OXYGEN SYSTEM FILL	┈	REGULATED OXYGEN
┄	HIGH PRESSURE OXYGEN	⇤	FILLER CHECK VALVES
▬ ▬ ▬	REDUCED PRESSURE	⊛	OXYGEN SYSTEM FILLER VALVE

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Figure 2-17. Oxygen Supply System

Table 2-2. Oxygen Duration (sheet 1 of 7)

CREW MEMBER DURATION IN HOURS								
	CABIN ALTITUDE FEET	GAGE PRESSURE – PSI, U – 21A 11 CUBIC FOOT SYSTEM 2000	1800	1500	1200	900	600	300
ONE MAN CREW	10,000	0.6 2.2	0.6 1.9	0.5 1.6	0.4 1.3	0.3 1.0	0.2 0.6	0.1 0.3
	15,000	0.8 2.2	0.7 1.9	0.6 1.6	0.5 1.3	0.3 1.0	0.2 0.6	0.1 0.3
	20,000	1.0 1.8	0.9 1.6	0.8 1.3	0.6 1.1	0.5 0.8	0.3 0.5	0.1 0.3
TWO MAN CREW	10,000	0.3 1.1	0.3 1.0	0.2 0.8	0.2 0.6	0.1 0.5	0.1 0.3	0.0 0.2
	15,000	0.4 1.1	0.3 1.0	0.3 0.8	0.2 0.6	0.2 0.5	0.1 0.3	0.1 0.2
	20,000	0.5 0.9	0.5 0.8	0.4 0.7	0.3 0.5	0.2 0.4	0.2 0.3	0.1 0.1
TWO MAN CREW PLUS ONE PASS	10,000	0.3 0.8	0.3 0.7	0.2 0.6	0.2 0.5	0.1 0.4	0.1 0.2	0.0 0.1
	15,000	0.3 0.8	0.3 0.7	0.3 0.6	0.2 0.5	0.1 0.3	0.1 0.2	0.0 0.1
	20,000	0.4 0.7	0.4 0.6	0.3 0.5	0.3 0.4	0.2 0.3	0.1 0.2	0.1 0.1
TWO MAN CREW PLUS TWO PASS	10,000	0.3 0.6	0.2 0.6	0.2 0.5	0.2 0.4	0.1 0.3	0.1 0.2	0.0 0.1
	15,000	0.3 0.6	0.3 0.6	0.2 0.5	0.2 0.4	0.1 0.3	0.1 0.2	0.0 0.1
	20,000	0.4 0.5	0.3 0.5	0.3 0.4	0.2 0.3	0.2 0.2	0.1 0.2	0.1 0.1
TWO MAN CREW PLUS THREE PASS	10,000	0.2 0.5	0.2 0.5	0.2 0.4	0.1 0.3	0.1 0.2	0.1 0.2	0.0 0.1
	15,000	0.3 0.5	0.2 0.5	0.2 0.4	0.2 0.3	0.1 0.2	0.1 0.2	0.0 0.1
	20,000	0.3 0.4	0.3 0.4	0.2 0.3	0.2 0.3	0.1 0.2	0.1 0.1	0.0 0.1
TWO MAN CREW PLUS FOUR PASS	10,000	0.2 0.5	0.2 0.4	0.2 0.3	0.1 0.3	0.1 0.2	0.1 0.1	0.0 0.1
	15,000	0.2 0.4	0.2 0.4	0.2 0.3	0.1 0.3	0.1 0.2	0.1 0.1	0.0 0.1
	20,000	0.3 0.4	0.3 0.3	0.2 0.3	0.2 0.2	0.1 0.2	0.1 0.1	0.0 0.1
TWO MAN CREW PLUS FIVE PASS	10,000	0.2 0.4	0.2 0.4	0.2 0.3	0.1 0.2	0.1 0.2	0.1 0.1	0.0 0.1
	15,000	0.2 0.4	0.2 0.3	0.2 0.3	0.1 0.2	0.1 0.2	0.1 0.1	0.0 0.1
	20,000	0.3 0.3	0.2 0.3	0.2 0.2	0.2 0.2	0.1 0.1	0.1 0.1	0.0 0.0
TWO MAN CREW PLUS SIX PASS	10,000	0.2 0.4	0.2 0.3	0.1 0.3	0.1 0.2	0.1 0.2	0.1 0.1	0.0 0.1
	15,000	0.2 0.3	0.2 0.3	0.2 0.2	0.1 0.2	0.1 0.1	0.1 0.1	0.0 0.0
	20,000	0.2 0.3	0.2 0.3	0.2 0.2	0.1 0.2	0.1 0.1	0.1 0.1	0.0 0.0

NOTES:
1. Top figures indicate 100 percent oxygen mode.
2. Bottom figures indicate normal oxygen, diluter-demand mode.
3. For conservative time estimates, use next lower gage pressure.

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Table 2-2. Oxygen Duration (sheet 2 of 7)

CREW MEMBER DURATION IN HOURS

	CABIN ALTITUDE FEET	GAGE PRESSURE – PSI, U – 21A 64 CUBIC FOOT SYSTEM						
		2000	1800	1500	1200	900	600	300
ONE MAN CREW	10,000	3.6 12.5	3.2 11.3	2.7 9.4	2.1 7.5	1.6 5.6	1.1 3.7	0.5 1.8
	15,000	4.4 12.5	4.0 11.3	3.3 9.4	2.6 7.5	2.0 5.6	1.3 3.7	0.6 1.8
	20,000	5.9 10.4	5.3 9.3	4.4 7.8	3.5 6.2	2.6 4.6	1.7 3.1	0.9 1.5
TWO MAN CREW	10,000	1.8 6.3	1.6 5.6	1.3 4.7	1.1 3.7	0.8 2.8	0.5 1.9	0.3 0.9
	15,000	2.2 6.3	2.0 5.6	1.7 4.7	1.3 3.7	1.0 2.8	0.7 1.9	0.3 0.9
	20,000	2.9 5.2	2.7 4.7	2.2 3.9	1.8 3.1	1.3 2.3	0.9 1.5	0.4 0.8
TWO MAN CREW PLUS ONE PASS	10,000	1.6 4.7	1.5 4.2	1.2 3.5	1.0 2.8	0.7 2.1	0.5 1.4	0.2 0.7
	15,000	2.0 4.6	1.8 4.1	1.5 3.4	1.2 2.7	0.9 2.0	0.6 1.3	0.3 0.7
	20,000	2.5 3.9	2.2 3.5	1.8 2.9	1.5 2.3	1.1 1.7	0.7 1.1	0.4 0.6
TWO MAN CREW PLUS TWO PASS	10,000	1.5 3.8	1.4 3.4	1.1 2.8	0.9 2.2	0.7 1.7	0.4 1.1	0.2 0.5
	15,000	1.7 3.6	1.6 3.2	1.3 2.7	1.0 2.1	0.8 1.6	0.5 1.1	0.3 0.5
	20,000	2.1 3.1	1.9 2.8	1.6 2.3	1.3 1.8	0.9 1.4	0.6 0.9	0.3 0.4
TWO MAN CREW PLUS THREE PASS	10,000	1.4 3.1	1.3 2.8	1.0 2.3	0.8 1.9	0.6 1.4	0.4 0.9	0.2 0.5
	15,000	1.6 2.9	1.4 2.7	1.2 2.2	0.9 1.8	0.7 1.3	0.5 0.9	0.2 0.4
	20,000	1.9 2.6	1.7 2.3	1.4 1.9	1.1 1.5	0.8 1.1	0.6 0.8	0.3 0.4
TWO MAN CREW PLUS FOUR PASS	10,000	1.3 2.7	1.2 2.4	1.0 2.0	0.8 1.6	0.6 1.2	0.4 0.8	0.2 0.4
	15,000	1.4 2.5	1.3 2.3	1.1 1.9	0.9 1.5	0.6 1.1	0.4 0.7	0.2 0.4
	20,000	1.7 2.2	1.5 2.0	1.2 1.6	1.0 1.3	0.7 1.0	0.5 0.6	0.2 0.3
TWO MAN CREW PLUS FIVE PASS	10,000	1.2 2.3	1.1 2.1	0.9 1.8	0.7 1.4	0.5 1.0	0.4 0.7	0.2 0.3
	15,000	1.3 2.2	1.2 2.0	1.0 1.6	0.8 1.3	0.6 1.0	0.4 0.6	0.2 0.3
	20,000	1.5 1.9	1.3 1.7	1.1 1.4	0.9 1.1	0.7 0.9	0.4 0.6	0.2 0.3
TWO MAN CREW PLUS SIX PASS	10,000	1.1 2.1	1.0 1.9	0.9 1.6	0.7 1.2	0.5 0.9	0.3 0.6	0.2 0.3
	15,000	1.2 1.9	1.1 1.7	0.9 1.4	0.7 1.2	0.6 0.9	0.4 0.6	0.2 0.3
	20,000	1.4 1.7	1.2 1.5	1.0 1.3	0.8 1.0	0.6 0.8	0.4 0.5	0.2 0.2

NOTES:
1. Top figures indicate 100 percent oxygen mode.
2. Bottom figures indicate normal oxygen, diluter-demand mode.
3. For conservative time estimates, use next lower gage pressure.

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Table 2-2. Oxygen Duration (sheet 3 of 7)

CREW MEMBER DURATION IN HOURS

	CABIN ALTITUDE FEET	GAGE PRESSURE - PSI, U - 21A 75 CUBIC FOOT SYSTEM						
		2000	1800	1500	1200	900	600	300
ONE MAN CREW	10,000	4.2 14.7	3.8 13.2	3.1 11.0	2.5 8.8	1.9 6.6	1.2 4.3	0.6 2.1
	15,000	5.2 14.7	4.7 13.2	3.9 11.0	3.1 8.8	2.3 6.6	1.5 4.3	0.8 2.1
	20,000	6.9 12.1	6.2 10.9	5.2 9.1	4.1 7.3	3.1 5.4	2.0 3.6	1.0 1.8
TWO MAN CREW	10,000	2.1 7.3	1.9 6.6	1.6 5.5	1.3 4.4	0.9 3.3	0.6 2.2	0.3 1.1
	15,000	2.6 7.3	2.3 6.6	1.9 5.5	1.5 4.4	1.2 3.3	0.8 2.2	0.4 1.1
	20,000	3.5 6.1	3.1 5.5	2.6 4.5	2.1 3.6	1.5 2.7	1.0 1.8	0.5 0.9
TWO MAN CREW PLUS ONE PASS	10,000	1.9 5.5	1.7 4.9	1.4 4.1	1.1 3.3	0.9 2.5	0.6 1.6	0.3 0.8
	15,000	2.3 5.3	2.1 4.8	1.7 4.0	1.4 3.2	1.0 2.4	0.7 1.6	0.3 0.8
	20,000	2.9 4.5	2.6 4.1	2.2 3.4	1.7 2.7	1.3 2.0	0.9 1.3	0.4 0.7
TWO MAN CREW PLUS TWO PASS	10,000	1.8 4.4	1.6 4.0	1.3 3.3	1.1 2.6	0.8 2.0	0.5 1.3	0.3 0.6
	15,000	2.0 4.2	1.8 3.8	1.5 3.1	1.2 2.5	0.9 1.9	0.6 1.2	0.3 0.6
	20,000	2.5 3.6	2.2 3.2	1.9 2.7	1.5 2.2	1.1 1.6	0.7 1.1	0.4 0.5
TWO MAN CREW PLUS THREE PASS	10,000	1.6 3.7	1.5 3.3	1.2 2.7	1.0 2.2	0.7 1.6	0.5 1.1	0.2 0.5
	15,000	1.9 3.5	1.7 3.1	1.4 2.6	1.1 2.1	0.8 1.5	0.5 1.0	0.3 0.5
	20,000	2.2 3.0	2.0 2.7	1.6 2.2	1.3 1.8	1.0 1.3	0.6 0.9	0.3 0.4
TWO MAN CREW PLUS FOUR PASS	10,000	1.5 3.1	1.4 2.8	1.1 2.4	0.9 1.9	0.7 1.4	0.4 0.9	0.2 0.5
	15,000	1.7 2.9	1.5 2.6	1.3 2.2	1.0 1.8	0.8 1.3	0.5 0.9	0.2 0.4
	20,000	1.9 2.6	1.7 2.3	1.5 1.9	1.2 1.5	0.9 1.1	0.6 0.8	0.3 0.4
TWO MAN CREW PLUS FIVE PASS	10,000	1.4 2.8	1.3 2.5	1.1 2.1	0.8 1.6	0.6 1.2	0.4 0.8	0.2 0.4
	15,000	1.6 2.6	1.4 2.3	1.2 1.9	0.9 1.5	0.7 1.1	0.5 0.8	0.2 0.4
	20,000	1.8 2.2	1.6 2.0	1.3 1.7	1.0 1.3	0.8 1.0	0.5 0.7	0.3 0.3
TWO MAN CREW PLUS SIX PASS	10,000	1.3 2.4	1.2 2.2	1.0 1.8	0.8 1.5	0.6 1.1	0.4 0.7	0.2 0.4
	15,000	1.4 2.3	1.3 2.0	1.1 1.7	0.9 1.3	0.6 1.0	0.4 0.7	0.2 0.3
	20,000	1.6 2.0	1.4 1.8	1.2 1.5	1.0 1.2	0.7 0.9	0.5 0.6	0.2 0.3

NOTES:
1. Top figures indicate 100 percent oxygen mode.
2. Bottom figures indicate normal oxygen, diluter-demand mode.
3. For conservative time estimates, use next lower gage pressure.

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Table 2-2. Oxygen Duration (sheet 4 of 7)

CREW MEMBER DURATION IN HOURS

	CABIN ALTITUDE FEET	GAGE PRESSURE - PSI, U-21A 128 CUBIC FOOT SYSTEM						
		2000	1800	1500	1200	900	600	300
ONE MAN CREW	10,000	7.2 25.0	6.4 22.5	5.4 18.8	4.3 15.0	3.2 11.2	2.1 7.4	1.0 3.6
	15,000	8.8 25.0	8.0 22.5	6.6 18.8	5.3 15.0	4.0 11.2	2.6 7.4	1.3 3.6
	20,000	11.8 20.7	10.6 18.6	8.8 15.5	7.0 12.4	5.3 9.3	3.5 6.1	1.7 3.0
TWO MAN CREW	10,000	3.6 12.5	3.2 11.3	2.7 9.4	2.1 7.5	1.6 5.6	1.1 3.7	0.5 1.8
	15,000	4.4 12.5	4.0 11.3	3.3 9.4	2.6 7.5	2.0 5.6	1.3 3.7	0.6 1.8
	20,000	5.9 10.4	5.3 9.3	4.4 7.8	3.5 6.2	2.6 4.6	1.7 3.1	0.9 1.5
TWO MAN CREW PLUS ONE PASS	10,000	3.3 9.4	2.9 8.4	2.4 7.0	2.0 5.6	1.5 4.2	1.0 2.8	0.5 1.4
	15,000	3.9 9.1	3.5 8.2	2.9 6.8	2.3 5.4	1.7 4.1	1.2 2.7	0.6 1.3
	20,000	4.9 7.7	4.4 6.9	3.7 5.8	3.0 4.6	2.2 3.5	1.5 2.3	0.7 1.1
TWO MAN CREW PLUS TWO PASS	10,000	3.0 7.5	2.7 6.8	2.3 5.6	1.8 4.5	1.3 3.4	0.9 2.2	0.4 1.1
	15,000	3.5 7.2	3.1 6.4	2.6 5.4	2.1 4.3	1.6 3.2	1.0 2.1	0.5 1.0
	20,000	4.2 6.2	3.8 5.5	3.2 4.6	2.5 3.7	1.9 2.8	1.3 1.8	0.6 0.9
TWO MAN CREW PLUS THREE PASS	10,000	2.8 6.3	2.5 5.6	2.1 4.7	1.7 3.7	1.2 2.8	0.8 1.9	0.4 0.9
	15,000	3.2 5.9	2.8 5.3	2.4 4.4	1.9 3.5	1.4 2.6	0.9 1.7	0.5 0.9
	20,000	3.7 5.1	3.3 4.6	2.8 3.8	2.2 3.1	1.7 2.3	1.1 1.5	0.5 0.7
TWO MAN CREW PLUS FOUR PASS	10,000	2.6 5.4	2.3 4.8	1.9 4.0	1.5 3.2	1.2 2.4	0.8 1.6	0.4 0.8
	15,000	2.9 5.0	2.6 4.5	2.2 3.8	1.7 3.0	1.3 2.2	0.9 1.5	0.4 0.7
	20,000	3.3 4.4	3.0 3.9	2.5 3.3	2.0 2.6	1.5 2.0	1.0 1.3	0.5 0.6
TWO MAN CREW PLUS FIVE PASS	10,000	2.4 4.7	2.2 4.2	1.8 3.5	1.4 2.8	1.1 2.1	0.7 1.4	0.4 0.7
	15,000	2.7 4.4	2.4 3.9	2.0 3.3	1.6 2.6	1.2 1.9	0.8 1.3	0.4 0.6
	20,000	3.0 3.8	2.7 3.4	2.2 2.9	1.8 2.3	1.3 1.7	0.9 1.1	0.4 0.6
TWO MAN CREW PLUS SIX PASS	10,000	2.3 4.2	2.0 3.8	1.7 3.1	1.4 2.5	1.0 1.9	0.7 1.2	0.3 0.6
	15,000	2.5 3.9	2.2 3.5	1.8 2.9	1.5 2.3	1.1 1.7	0.7 1.1	0.4 0.6
	20,000	2.7 3.4	2.4 3.1	2.0 2.5	1.6 2.0	1.2 1.5	0.8 1.0	0.4 0.5

NOTES:

1. Top figures indicate 100 percent oxygen mode.
2. Bottom figures indicate normal oxygen, diluter-demand mode.
3. For conservative time estimates, use next lower gage pressure.

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Table 2-2. Oxygen Duration (sheet 5 of 7)

CREW MEMBER DURATION IN HOURS

	CABIN ALTITUDE FEET	GAGE PRESSURE – PSI, U – 21A 139 CUBIC FOOT SYSTEM 2000	1800	1500	1200	900	600	300
ONE MAN CREW	10,000	7.8 27.2	7.0 24.5	5.8 20.4	4.6 16.3	3.5 12.2	2.3 8.1	1.1 4.0
	15,000	9.6 27.2	8.6 24.5	7.2 20.4	5.7 16.3	4.3 12.2	2.8 8.1	1.4 4.0
	20,000	12.8 22.5	11.5 20.2	9.6 16.9	7.7 13.5	5.7 10.1	3.8 6.7	1.9 3.3
TWO MAN CREW	10,000	3.9 13.6	3.5 12.2	2.9 10.2	2.3 8.1	1.7 6.1	1.2 4.0	0.6 2.0
	15,000	4.8 13.6	4.3 12.2	3.6 10.2	2.9 8.1	2.1 6.1	1.4 4.0	0.7 2.0
	20,000	6.4 11.3	5.8 10.1	4.8 8.4	3.8 6.7	2.9 5.0	1.9 3.3	0.9 1.6
TWO MAN CREW PLUS ONE PASS	10,000	3.5 10.2	3.2 9.2	2.7 7.6	2.1 6.1	1.6 4.6	1.1 3.0	0.5 1.5
	15,000	4.2 9.9	3.8 8.9	3.2 7.4	2.5 5.9	1.9 4.4	1.3 2.9	0.6 1.4
	20,000	5.4 8.4	4.8 7.5	4.0 6.3	3.2 5.0	2.4 3.8	1.6 2.5	0.8 1.2
TWO MAN CREW PLUS TWO PASS	10,000	3.3 8.2	2.9 7.3	2.4 6.1	2.0 4.9	1.5 3.6	1.0 2.4	0.5 1.2
	15,000	3.8 7.8	3.4 7.0	2.8 5.8	2.3 4.6	1.7 3.5	1.1 2.3	0.6 1.1
	20,000	4.6 6.7	4.1 6.0	3.5 5.0	2.8 4.0	2.1 3.0	1.4 2.0	0.7 1.0
TWO MAN CREW PLUS THREE PASS	10,000	3.0 6.8	2.7 6.1	2.3 5.1	1.8 4.1	1.4 3.0	0.9 2.0	0.4 1.0
	15,000	3.4 6.4	3.1 5.8	2.6 4.8	2.1 3.8	1.5 2.9	1.0 1.9	0.5 0.9
	20,000	4.0 5.6	3.6 5.0	3.0 4.2	2.4 3.3	1.8 2.5	1.2 1.6	0.6 0.8
TWO MAN CREW PLUS FOUR PASS	10,000	2.8 5.8	2.5 5.2	2.1 4.4	1.7 3.5	1.3 2.6	0.8 1.7	0.4 0.8
	15,000	3.1 5.4	2.8 4.9	2.3 4.1	1.9 3.3	1.4 2.4	0.9 1.6	0.5 0.8
	20,000	3.6 4.8	3.2 4.3	2.7 3.6	2.2 2.8	1.6 2.1	1.1 1.4	0.5 0.7
TWO MAN CREW PLUS FIVE PASS	10,000	2.6 5.1	2.4 4.6	2.0 3.8	1.6 3.0	1.2 2.3	0.8 1.5	0.4 0.7
	15,000	2.9 4.7	2.6 4.3	2.2 3.5	1.7 2.8	1.3 2.1	0.9 1.4	0.4 0.7
	20,000	3.2 4.2	2.9 3.7	2.4 3.1	1.9 2.5	1.5 1.9	1.0 1.2	0.5 0.6
TWO MAN CREW PLUS SIX PASS	10,000	2.5 4.5	2.2 4.1	1.9 3.4	1.5 2.7	1.1 2.0	0.7 1.3	0.4 0.7
	15,000	2.7 4.2	2.4 3.8	2.0 3.1	1.6 2.5	1.2 1.9	0.8 1.2	0.4 0.6
	20,000	3.0 3.7	2.7 3.3	2.2 2.8	1.8 2.2	1.3 1.7	0.9 1.1	0.4 0.5

NOTES:

1. Top figures indicate 100 percent oxygen mode.
2. Bottom figures indicate normal oxygen, diluter-demand mode.
3. For conservative time estimates, use next lower gage pressure.

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Table 2-2. Oxygen Duration (sheet 6 of 7)

CREW MEMBER DURATION IN HOURS								
	CABIN ALTITUDE FEET	GAGE PRESSURE - PSI, U-21A 192 CUBIC FOOT SYSTEM						
		2000	1800	1500	1200	900	600	300
ONE MAN CREW	10,000	10.7 37.6	9.7 33.8	8.0 28.1	6.4 22.5	4.8 16.8	3.2 11.1	1.6 5.5
	15,000	13.3 37.6	11.9 33.8	9.9 28.1	7.9 22.5	5.9 16.8	3.9 11.1	1.9 5.5
	20,000	17.7 31.1	15.9 28.0	13.2 23.3	10.6 18.6	7.9 13.9	5.2 9.2	2.6 4.5
TWO MAN CREW	10,000	5.4 18.8	4.8 16.9	4.0 14.1	3.2 11.2	2.4 8.4	1.6 5.6	0.8 2.7
	15,000	6.6 18.8	6.0 16.9	5.0 14.1	4.0 11.2	3.0 8.4	2.0 5.6	1.0 2.7
	20,000	8.8 15.5	8.0 14.[illegible]	6.6 11.6	5.3 9.3	4.0 7.0	2.6 4.6	1.3 2.3
TWO MAN CREW PLUS ONE PASS	10,000	4.9 14.1	4.4 12.7	3.7 10.5	2.9 8.4	2.2 6.3	1.5 4.2	0.7 2.1
	15,000	5.9 13.7	5.3 12.3	4.4 10.2	3.5 8.2	2.6 6.1	1.7 4.0	0.9 2.0
	20,000	7.4 11.6	6.7 10.4	5.5 8.7	4.4 6.9	3.3 5.2	2.2 3.4	1.1 1.7
TWO MAN CREW PLUS TWO PASS	10,000	4.5 11.3	4.1 10.1	3.4 8.4	2.7 6.7	2.0 5.0	1.3 3.3	0.7 1.6
	15,000	5.2 10.7	4.7 9.7	3.9 8.0	3.1 6.4	2.3 4.8	1.6 3.2	0.8 1.6
	20,000	6.4 9.2	5.7 8.3	4.8 6.9	3.8 5.5	2.8 4.1	1.9 2.7	0.9 1.3
TWO MAN CREW PLUS THREE PASS	10,000	4.2 9.4	3.8 8.4	3.1 7.0	2.5 5.6	1.9 4.2	1.2 2.8	0.6 1.4
	15,000	4.7 8.8	4.3 8.0	3.6 6.6	2.8 5.3	2.1 4.0	1.4 2.6	0.7 1.3
	20,000	5.6 7.7	5.0 6.9	4.2 5.7	3.3 4.6	2.5 3.4	1.7 2.3	0.8 1.1
TWO MAN CREW PLUS FOUR PASS	10,000	3.9 8.0	3.5 7.2	2.9 6.0	2.3 4.8	1.7 3.6	1.2 2.4	0.6 1.2
	15,000	4.3 7.5	3.9 6.8	3.2 5.6	2.6 4.5	1.9 3.4	1.3 2.2	0.6 1.1
	20,000	5.0 6.6	4.5 5.9	3.7 4.9	3.0 3.9	2.2 2.9	1.5 1.9	0.7 1.0
TWO MAN CREW PLUS FIVE PASS	10,000	3.6 7.0	3.3 6.3	2.7 5.3	2.2 4.2	1.6 3.1	1.1 2.1	0.5 1.0
	15,000	4.0 6.5	3.6 5.9	3.0 4.9	2.4 3.9	1.8 2.9	1.2 1.9	0.6 1.0
	20,000	4.5 5.7	4.0 5.2	3.4 4.3	2.7 3.4	2.0 2.6	1.3 1.7	0.7 0.8
TWO MAN CREW PLUS SIX PASS	10,000	3.4 6.3	3.1 5.6	2.6 4.7	2.0 3.7	1.5 2.8	1.0 1.9	0.5 0.9
	15,000	3.7 5.8	3.3 5.2	2.8 4.3	2.2 3.5	1.7 2.6	1.1 1.7	0.5 0.8
	20,000	4.1 5.1	3.7 4.6	3.1 3.8	2.4 3.0	1.8 2.3	1.2 1.5	0.6 0.7

NOTES:
1. Top figures indicate 100 percent oxygen mode.
2. Bottom figures indicate normal oxygen, diluter-demand mode.
3. For conservative time estimates, use next lower gage pressure.

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Table 2-2. Oxygen Duration (sheet 7 of 7)

CREW MEMBER DURATION IN HOURS

	CABIN ALTITUDE FEET	GAGE PRESSURE – PSI, U – 21A 203 CUBIC FOOT SYSTEM						
		2000	1800	1500	1200	900	600	300
ONE MAN CREW	10,000	11.3 39.7	10.2 35.7	8.5 29.7	6.8 23.7	5.1 17.8	3.4 11.8	1.7 5.8
	15,000	14.0 39.7	12.6 35.7	10.5 29.7	8.4 23.7	6.3 17.8	4.2 11.8	2.0 5.8
	20,000	18.7 32.9	16.8 29.6	14.0 24.6	11.2 19.7	8.4 14.7	5.5 9.7	2.7 4.8
TWO MAN CREW	10,000	5.7 19.9	5.1 17.9	4.2 14.9	3.4 11.9	2.5 8.9	1.7 5.9	0.8 2.9
	15,000	7.0 19.9	6.3 17.9	5.2 14.9	4.2 11.9	3.1 8.9	2.1 5.9	1.0 2.9
	20,000	9.3 16.4	8.4 14.8	7.0 12.3	5.6 9.8	4.2 7.3	2.8 4.9	1.4 2.4
TWO MAN CREW PLUS ONE PASS	10,000	5.2 14.9	4.7 13.4	3.9 11.2	3.1 8.9	2.3 6.7	1.5 4.4	0.8 2.2
	15,000	6.2 14.4	5.6 13.0	4.6 10.8	3.7 8.6	2.8 6.5	1.8 4.3	0.9 2.1
	20,000	7.8 12.3	7.0 11.0	5.9 9.2	4.7 7.3	3.5 5.5	2.3 3.6	1.1 1.8
TWO MAN CREW PLUS TWO PASS	10,000	4.8 11.9	4.3 10.7	3.6 8.9	2.8 7.1	2.1 5.3	1.4 3.5	0.7 1.7
	15,000	5.5 11.3	5.0 10.2	4.1 8.5	3.3 6.8	2.5 5.1	1.6 3.4	0.8 1.7
	20,000	6.7 9.8	6.1 8.8	5.0 7.3	4.0 5.8	3.0 4.4	2.0 2.9	1.0 1.4
TWO MAN CREW PLUS THREE PASS	10,000	4.4 9.9	4.0 8.9	3.3 7.4	2.6 5.9	2.0 4.4	1.3 2.9	0.6 1.4
	15,000	5.0 9.3	4.5 8.4	3.8 7.0	3.0 5.6	2.2 4.2	1.5 2.8	0.7 1.4
	20,000	5.9 8.1	5.3 7.3	4.4 6.1	3.5 4.9	2.6 3.6	1.8 2.4	0.9 1.2
TWO MAN CREW PLUS FOUR PASS	10,000	4.1 8.5	3.7 7.7	3.1 6.4	2.5 5.1	1.8 3.8	1.2 2.5	0.6 1.2
	15,000	4.6 7.9	4.1 7.1	3.4 5.9	2.7 4.7	2.0 3.6	1.4 2.4	0.7 1.2
	20,000	5.3 6.9	4.7 6.2	3.9 5.2	3.1 4.2	2.4 3.1	1.6 2.1	0.8 1.0
TWO MAN CREW PLUS FIVE PASS	10,000	3.8 7.4	3.5 6.7	2.9 5.6	2.3 4.5	1.7 3.3	1.1 2.2	0.6 1.1
	15,000	4.2 6.9	3.8 6.2	3.2 5.2	2.5 4.1	1.9 3.1	1.3 2.0	0.6 1.0
	20,000	4.7 6.1	4.3 5.5	3.6 4.5	2.8 3.6	2.1 2.7	1.4 1.8	0.7 0.9
TWO MAN CREW PLUS SIX PASS	10,000	3.6 6.6	3.2 6.0	2.7 5.0	2.2 4.0	1.6 3.0	1.1 2.0	0.5 1.0
	15,000	3.9 6.1	3.5 5.5	2.9 4.6	2.3 3.7	1.7 2.7	1.2 1.8	0.6 0.9
	20,000	4.3 5.4	3.9 4.8	3.2 4.0	2.6 3.2	1.9 2.4	1.3 1.6	0.6 0.8

NOTES:
1. Top figures indicate 100 percent oxygen mode.
2. Bottom figures indicate normal oxygen, diluter-demand mode.
3. For conservative time estimates, use next lower gage pressure.

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NOTE

A loss of oxygen will occur if the CABIN OXYGEN valve is OPEN, and a passenger oxygen mask is connected to any of the outlets.

a. Normal Operation. Oxygen pressure is maintained at all times to the regulator control panels if the cylinder shut-off valves are on and if there is pressure in the cylinders. Each individual places the supply lever (green) on his regulator control panel to the ON position, the diluter lever (white) to the NORMAL OXYGEN position. To obtain oxygen for the passengers, the pilot rotates the CABIN OXYGEN valve to OPEN causing 100% oxygen to flow continuously into the distribution lines which supply passenger masks coupled into the service outlets.

NOTE

The shutoff valves of high pressure oxygen systems should be opened fully to prevent the possibility of leakage.

b. Emergency Operation. For emergency operation, the affected crew member selects the EMERGENCY position of the emergency pressure control lever on his oxygen regulator control panel. This selection provides 100% oxygen, at a positive pressure, regardless of the position of the diluter control lever on his panel.

2-59. Windshield Wipers,

a. Description. Two electrically operated windshield wipers are provided for use at takeoff and landing speed (fig. 2-5). Operation at cruise speed may result in damage to the wiper operating mechanism. A rotary switch (fig.2-21), placarded WINDSHIELD WIPER, located on the overhead control panel, selects mode of windshield wiper operation. An information placard below the switch states: DO NOT OPERATE ON DRY GLASS. Function positions on the switch, as read clockwise, are placarded: PARK - OFF - SLOW - FAST. When the switch is held in the spring-loaded PARK setting, the blades will return to their normal inoperative position on the glass, then, when released, the switch will return to OFF position terminating windshield wiper operation. The FAST and SLOW switch positions are separate operating speed settings for wiper operation. The windshield wiper circuit is protected by one 10-ampere circuit breaker, placarded WSHLD WIPER, located on the right subpanel (fig. 2-18).

CAUTION

Do not operate windshield wipers on dry glass. Such action can damage the linkage as well as scratch the windshield glass.

b. Normal Operation. To start turn WINDSHIELD WIPER switch to FAST or SLOW speed, as desired. To stop turn the switch to the PARK position and release. The blades will return to their normal inoperative position and stop. Turning the switch only to the OFF position will stop the windshield wipers, without returning them to the normal inactive position.

2-60. Stall Warning System.

Approach to a stall is indicated by a steady tone of a warning horn located behind the right subpanel. A small metal vane located on the left wing leading edge, is moved by any change in airflow over the leading edge of the wing. When the airspeed decreased to approximately 5 to 10 knots above stall speed, movement of the vane actuates switch which completes a DC electrical circuit to the stall warning horn. Since the vane is affected by the same aerodynamic forces that result in the stall, the system functions regardless of the type of stall or configuration of landing gear and wing flaps, the only variation in performance being the margin of airspeed at which the warning occurs. to prevent ice formations on the stall warning vane an electrically operated heating element is installed, which is controlled by a 10-ampere LH PITOT circuit breaker switch located on the left subpanel. The stall warning circuit is protected by a 5-ampere circuit breaker, placarded STALL WARN HORN, on the right subpanel (fig. 2-7) and a 5-ampere circuit breaker placarded STALL WARNING CKT BKR on a bracket below the battery box in the right center wing section (fig. 2-18).

2-61. Seating Provisions.

a. Troop Transport. The troop transport versions will accommodate ten combat equipped troops in the cabin with five non-adjustable, bench-type seat units. One side of each seat unit attaches to wall structure of the fuselage, and the other side is supported by foldable legs which insert into slotted tracks mounted on the floor. All seat units are removable, however, they may also be folded up and strapped close to the compartment walls using straps attached for that purpose. Six seat positions are located along the right wall and four along the left wall. All face the center aisle. Combat equipment and personnel packs may be stowed beneath the seats. Seat belts are installed at each seat position.

b. Air Ambulance. When configured for air ambulance use the cabin has three seating positions to accommodate medical attendants and ambulatory patients, and provisions to install three litters. The three forward seat positions along the right side are utilized. Litter suspension mountings are provided for two litters on the aft-right side, and one litter on the left-forward side.

c. Staff Transport. When configured as staff transport the cabin has six forward-facing chair seats, three on each side of the center aisle. All chair seats attach to floor railings on each side of the center aisle and are quickly removable for converting the aircraft to an alternate version.

d. Cargo Transport. Troop seat units can be folded up to prevent conflict with the cargo mission, or may be removed, if required.

2-62. Cigarette Lighters and Ash Trays.

One electrical push-in type cigarette lighter is located on the pilot's control pedestal (fig. 2-6). A push-pull type ash tray is built into the inboard arm rest of the pilot's and copilot's seats. The circuit is protected by a 5-ampere circuit breaker, placarded CIGARETTE LIGHTER COCKPIT, on the right subpanel (fig. 2-18).

6-63. Relief Tubes.

Two relief tubes are provided, one under the pilot's seat and the other located aft of the main entrance door in the aft cabin.

2-64. Rear View Mirror.

A single rear-view type mirror is externally mounted below the pilot's side window to enable surveillance along the left fuselage and aft tail surfaces (fig- 2-5). Sighting angle of the mirror is adjustable from within the cockpit using a rotary control knob located aft of the fuel management panel (fig. 2-5). When not in use, the mirror may be adjusted to streamline against the fuselage exterior for minimum drag.

2-65. Sun Visors.

CAUTION

When adjusting the sun visors, grasp only by the top metal attachment to avoid damage to the plastic shield.

Two sun visors are provided for the pilot and copilot respectively (fig. 2-5). Each visor is manually adjustable. When not needed as a sun shield, each visor may be manually rotated to a position flush with the top of the cockpit so that it does not obstruct view through the windows.

SECTION VIII. HEATING, VENTILATION, COOLING, AND ENVIRONMENTAL CONTROL UNIT

2-66. Heating and Ventilation Systems.

a. Description. The heating and ventilation system operates utilizing fresh air from outside of the aircraft. On the ground, the outside air enters the system cold air plenum through the ventilation louvers in the left door of the nose avionics compartment. Two ventilation air blowers operate only while the aircraft is on the ground, forcing air from the nose avionics compartment into the cold air plenum. When the aircraft becomes airborne, a switch on the left main landing gear strut turns the blowers off. Part of the ram air bypasses the heater and is ducted to the nose avionics compartment, and to the cold air outlets in both the cockpit and cabin. The remainder of the air is ducted into the heater. After the air is heated, it is ducted to three warm air outlets in the cabin, and to the two warm air and defroster outlets in the cockpit. The cockpit's warm air outlets are just above each set of rudder pedals. The cabin warm air outlets are located at floor level. Stale air is vented through the exhaust air plenum installed in the cabin ceiling.

(1) Vent blower and switch. A switch, placarded VENT BLWR, on the right subpanel, controls activation of the blowers for the cabin ventilation system (fig. 2-7). VENT BLWR position, activates the ventilation blowers for cooling air when the aircraft is on the ground. When the aircraft becomes airborne, a switch on the left main gears turns the ventilation blower circuits off. Circuits are protected by a 20-ampere circuit breaker placarded VENT BLOWER POWER located on the copilot's circuit breaker and fuse panel (fig. 2-18).

(2) Fresh air outlets. Fresh air is ducted directly from the fresh air plenum to individual outlets in the cockpit and cabin positioned in the ceiling above the seats. Air flow volume is controlled at

each outlet. The direction of air flow is controlled by moving an outlet in its spherical socket.

(3) Stale air exhaust system. Stale air is exhausted from the cabin area through the exhaust plenum in the cabin ceiling and is ducted to two vents located in the cabin on each side of the fuselage.

(4) Push-pull cockpit ventilation control. Two push-pull type air inlet controls, placarded VENT AIR - PUSH ON, are located below the pilot and copilot subpanels to manually regulate cockpit ventilation. When pushed IN, either control will cause outside air to flow from outlets above the respective rudder pedals. As a control is pulled out, there is a corresponding decrease in the amount of air flow.

(5) Push-pull cabin ventilation control. A push-pull type control, placarded CABIN AIR, located on the right subpanel (fig. 2-7), manually controls ventilation of the cabin. Airflow is at maximum when the control is pushed in. As the control is pulled out there is a corresponding decrease in the amount of air flow.

(6) Heater combustion unit. The heater is a combustion unit that uses the same fuels at the engines. The heater is located in the lower right side of the nose avionics compartment. Air for combustion is ducted from the nose avionics compartment to a combustion blower which forces air into the combustion chamber. Taking air from the nose avionics compartment helps to cool the compartment by absorbing heat from installed electronic equipment. The combustion blower operates on the ground whenever electrical power is applied.

(7) Heater fuel pump. A heater fuel pump in the wing outboard of the fuselage, forward of the main wing spar, operates whenever the heater control switch is ON. Fuel for the heater is obtained through a supply line coupled into the gravity feed fuel line at a location between the wing tanks and the left nacelle tank. The cabin heater will continue to operate until all fuel is consumed from the left nacelle tank.

(8) Pressure differential switch and duct temperature thermal switch. When either combustion blower air flow or vent blower air flow is insufficient, a differential pressure switch prevents heater operation. Also, to prevent heat damage to equipment located adjacent to a heater outlet, a duct temperature thermal switch allows the ventilation blower to continue operation on the ground after heater shutdown to purge heat from the system. This switch will shut off the ventilation blower when duct temperature is reduced to 52°C.

(9) Heater cycling switch. A cycling switch located in the air plenum disconnects power to the heater fuel solenoid valve at 107°C. If this automatic function should fail, temperature within the plenum will ultimately exceed 149°C and cause a 5-ampere fuse to blow, shutting down the heater. The 5-ampere fuse, which is in series with the HTR control switch and the TEMP CONTROL circuit breaker, cannot be replaced in flight due to its location.

(10) Heater control switch. A switch placarded HEATER MAN, OFF, and AUTO located on the right subpanel, controls cabin heater operation. Either mode, AUTO or MAN, will activate the combustion air blower, the ventilation blower (if aircraft is on the ground), the heater fuel pump, open the fuel solenoid valve, and deliver power to the igniter for combustion. AUTO position of the heater control switch activates the cabin heater system and couples it with a temperature-regulation circuit, which maintains cabin heat between 18°C and 29°C, as established by the temperature control thermostat. MAN position activates the cabin heater system, but cuts out the temperature-regulation circuit, allowing the heater to operate continuously until limit switches within the hot air plenum cuts it off at either 107°C or 149°C.

(11) Temperature control circuit breakers. The combustion blower, igniter fuel pump, heater control box, and all sensing and regulating circuits are protected by a single 20-ampere circuit breaker, placarded TEMP CONTROL, located on the copilot's circuit breaker and fuse panel.

(12) Cabin temperature rheostat. A rheostat, placarded CABIN TEMP, located on the right subpanel, controls cabin temperature between 18°C and 29°C in the AUTO mode of cabin heater operation.

(13) Cabin heat out indicator light. A red press-to-test light, placarded CABIN HEAT OUT located on the copilot's instrument panel, illuminates if the cabin heater is inoperative (heater control switch ON or at AUTO and cabin temperature lower than 18°C).

b. Normal Operation - Cabin Heat.

NOTE

Operation with GPU is the same as operation with aircraft power.

(1) Vent blower operation - Check.

(2) HTR switch - AUTO.

(3) CABIN TEMP control - As required.

(4) CABIN AIR, VENT AIR, and DEFROST AIR controls - As required.

NOTE

The heater and defroster will be inoperative when left wing tanks have less than 28 gallons remaining.

NOTE

For maximum defrosting, pull out the CABIN AIR, VENT AIR, and DEFROST AIR controls and place the HTR switch to MAN. Regulate the cabin temperature by opening one or more of the cold air outlets.

c. Emergency Operation - Cabin Heat. If the automatic temperature control should fail to operate, the temperature may be controlled manually by manipulating the HTR control switch between the OFF and MAN positions.

d. Flight Time Remaining at Cabin Heater Cutoff. Flight time and range capability of the aircraft are effected by combustion requirements of the cabin heater, using fuel from the same left wing storage system which feeds the left engine. However, as the fuel level drops within the left wing tanks to a near depletion quantity , a safety feature associated with gravity feed stops the supply of fuel to the heater. This action reserves the final quantity for propulsion only. Available flight time following cabin heater cutoff will vary due to the interaction of several factors.One factor is pilot technique in fuel management and others are associated with the operation of automatic components of the fuel system.

e. Normal Operation - Ventilation System.

(1) HTR switch - OFF.

(2) VENT BLOWER switch - ON.

(3) Cold air outlets - Adjust and required.

(4) CABIN AIR and VENT AIR controls - Position as required.

NOTE

With the heater control switch off, cold air will enter the cockpit and cabin through the warm air outlets.

NOTE

The ventilation air blower operates only when the aircraft is on the ground with landing gear shock struts compressed by aircraft weight.

SECTION IX. ELECTRICAL POWER SUPPLY AND DISTRIBUTION SYSTEM

2-67. Description.

This aircraft employs both direct current (CD) and alternating current (AC) electrical power (fig. 2-19). The DC electrical supply forms the basic power system, energizing most aircraft circuits. Electrical power is used to start the engines, to power the landing gear and flap motors, and to operate the transfer and fuel pumps, heater blower, ventilation blower, lights and electronic equipment. AC power is obtained from DC power through inverters. The three sources of DC power consist of one 24-volt, 34-ampere/hour battery and two 250-ampere starter-generators. The starter-generators are controlled by solid state regulators. A split bus system with a paralleling circuit balances the load between the two generators. When a generator is not operating, a diode prevents reverse current from the supply bus. Over-voltage protection is provided by two over-voltage relays, which can interrupt generator field current to remove an affected unit from the bus. Two volt-loadmeters indicate generator loads. Generator and battery switches are positioned under the MASTER SWITCH gang bar for simultaneous cutoff. An external receptacle for DC power is installed in the right nacelle. Electrical power is used to start the engine, to power the the landing gear and flap retraction mechanisms, and to operate the fuel pumps, heater fan, lights, and electronic gear.

2-68. DC Power Supply.

One nickel-cadmium battery furnishes DC power when the engines are not operating. This is a 24-volt, 34-ampere/hour battery, located in the right wing center section, and accessible through a panel on the top of the wing. DC power is produced by two engine-driven 28-volt, 250-ampere starter-generators. Controls and indicators associated with the DC supply system are located on the left subpanel, and consist of a single battery switch (BAT), two generator switches (GEN 1 and GEN 2), a single MASTER SWITCH and two volt-loadmeters. (Refer to Section VII, UTILITLY SYSTEMS for battery vent system anti-icing.)

a. Battery Switch. A switch, placarded BAT, is located on the left subpanel under a bar identified MASTER SWITCH. The BAT switch controls DC power to the aircraft bus system through the battery relay. Positions of the switch are not placarded, however "-on" setting is up which raises the MASTER SWITCH bar. When the bar is placed down, the BAT switch is forced "off".

b. Generator Switches. Two toggle switches, placarded GEN 1 and GEN 2, are located on the left subpanel under the MASTER SWITCH (fig. 2-7). Each switch controls power from the designated generator into paralleling circuits and the bus distribution system. Positions are not placarded. ON setting is "up" and OFF setting is "down". When a switch is positioned "up", the MASTER SWITCH bar is raised. When the bar is moved down, the switches are forced OFF.

c. Master Switch. All electrical current may be shut off using the MASTER SWITCH bar (fig. 2-7) which extends above the battery and generator switches. The MASTER SWITCH bar is raised when a battery or generator switch is turned on. Placed down the bar forces each switch to the OFF position.

d. Volt-Loadmeters. Two meters on the left subpanel display voltage readings and show the electrical load from left and right generating systems (fig. 2-7). Each meter is equipped with a spring-loaded push-button switch which when manually pressed will cause the meter to indicate main bus voltage. Each meter normally shows output electrical load from the respective generator, unless the push-button switch is pressed to obtain bus voltage reading. Current consumption is indicated as a percentage of total output amperage capacity for the generating system monitored.

e. Battery Monitor. Nickel-cadmium battery overheating will cause the battery charge current to increase. The aircraft has a charge-current sensor which will detect a charge current. The charge current system senses battery current through a shunt in the negative lead of the battery. Any time the battery charging current exceeds approximately 7-amperes for 6 seconds or longer, the yellow BATTERY CHARGE annunciator light master fault caution light will illuminate. Following a battery engine start, the BATTERY CHARGE annunciator light will illuminate approximately six seconds after the generator switch is placed in the ON position. The light will normally extinguish within two to five minutes, indicating that the battery is approaching a full charge. The time interval will increase if the battery has a low state of charge, the battery temperature is very low, or if the battery has previously been discharged at a very low rate (i.e., battery operation of radios or light for prolonged periods). The light may also illuminate for short intervals after landing gear and/or flap operation. If the light should illuminate during normal steady-state cruise, it indicates that conditions exist that may cause a battery thermal runaway. If this occurs the battery switch shall be turned OFF and may be turned back ON only for gear and flap extension and approach to landing.

NOTE

Battery may be usable after a 15 to 20 minute cool down period.

f. Generator Out Warning Lights. Two annunciator panel fault lights inform the pilot when either generator is not delivering current to the aircraft DC bus system. These lights are placarded LH GEN OUT and RH GEN OUT (fig. 2-22). Two flashing FAULT WARN lights and illumination of either fault light indicates that either the identified generator has failed or voltage if insufficient to keep it connected to the bus distribution system.

g. DC External power Source. External DC power can be applied to the aircraft through an external power receptacle on the underside of the right wind leading edge just outboard of the engine nacelle (fig. 2-23). The receptacle is installed inside of the wing structure and is accessible through a hinged access panel. DC power is supplied through the DC external plug and applied directly to the battery bus after passing through the external power relay. The holding coil circuit of the relay is energized by the external power source. The BAT switch must be in the ON position to connect external DC power to the aircraft circuits.

2-69. AC Power Supply.

AC electrical power for the aircraft is supplied by two inverters which receive operating current from the DC power system. The inverters are operated by a switch placarded INVERTERS LEFT, OFF, RIGHT, located on the pilot's subpanel. Only one inverter can be operated at a time. The second inverter remains as a spare to be used in case of AC power failure. The single-phase inverters provide 115 VAC power to the vertical and directional gyros. The inverters also provide 26 VAC power to the following engine instruments, fuel pressure, fuel flow, oil pressure, torquemeters; and avionics systems:HDG, RMI, compass, ADI, yaw damp.

a. AC Power Warning Lights. The loss of AC power is indicated on the Annunciator panel by

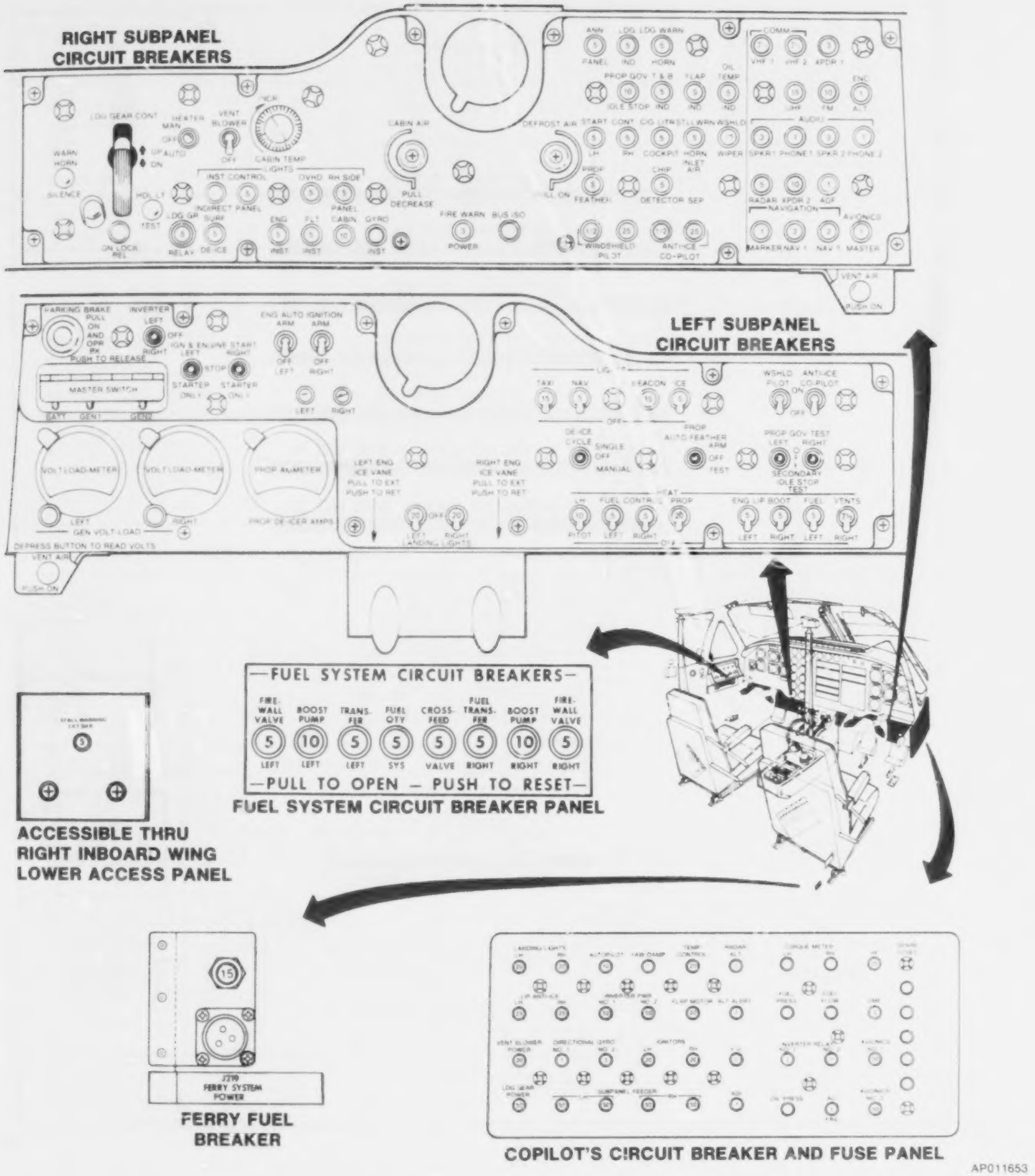

RIGHT SUBPANEL CIRCUIT BREAKERS
LEFT SUBPANEL CIRCUIT BREAKERS
—FUEL SYSTEM CIRCUIT BREAKERS—
FIRE-WALL VALVE 5 LEFT
BOOST PUMP 10 LEFT
TRANS-FER 5 LEFT
FUEL QTY 5 SYS
CROSS-FEED 5 VALVE
FUEL TRANS-FER 5 RIGHT
BOOST PUMP 10 RIGHT
FIRE-WALL VALVE 5 RIGHT
—PULL TO OPEN — PUSH TO RESET—
FUEL SYSTEM CIRCUIT BREAKER PANEL
ACCESSIBLE THRU RIGHT INBOARD WING LOWER ACCESS PANEL
J219 FERRY SYSTEM POWER
FERRY FUEL BREAKER
COPILOT'S CIRCUIT BREAKER AND FUSE PANEL
PARKING BRAKE PULL ON AND OPR 8K PUSH TO RELEASE
INVERTER LEFT OFF RIGHT
IGN & ENGINE START LEFT STOP RIGHT
STARTER ONLY
MASTER SWITCH
BATT GEN1 GEN2
VOLT LOAD METER
PROP AMMETER
GEN VOLT LOAD
DEPRESS BUTTON TO READ VOLTS
PROP DE-ICER AMPS
VENT AIR PUSH ON
ENG AUTO IGNITION ARM OFF LEFT RIGHT
LEFT ENG ICE VANE PULL TO EXT PUSH TO RET
RIGHT ENG ICE VANE PULL TO EXT PUSH TO RET
LANDING LIGHTS LEFT OFF RIGHT
LIGHTS TAXI NAV BEACON ICE
WSHLD PILOT ON OFF ANTI-ICE CO-PILOT
DE-ICE CYCLE SINGLE OFF MANUAL
PROP AUTO FEATHER ARM OFF TEST
PROP GOV TEST LEFT RIGHT
SECONDARY IDLE STOP TEST
HEAT PITOT LEFT FUEL CONTROL RIGHT PROP
ENG LIP BOOT LEFT RIGHT
FUEL VENTS LEFT RIGHT
LDG GEAR CONT UP DN
WARN HORN SILENCE
DN LOCK REL
HDL LT TEST
HEATER MAN OFF AUTO
VENT BLOWER OFF
CABIN TEMP INCR
CABIN AIR PULL DECREASE
DEFROST AIR PULL ON
FIRE WARN POWER
BUS ISO
LIGHTS INST CONTROL INDIRECT PANEL OVHD RH SIDE PANEL
LDG GR RELAY SURF DE-ICE
ENG INST FLT INST CABIN GYRO INST
ANN PANEL LDG IND LDG WARN HORN
PROP GOV IDLE STOP T & B IND FLAP IND OIL TEMP IND
START CONT LH RH CIG LTR COCKPIT STL WRN HORN WSHLD WIPER
PROP FEATHER CHIP DETECTOR INLET AIR SEP
WINDSHIELD PILOT ANTI-ICE CO-PILOT
COMM VHF 1 VHF 2 XPDR 1
UHF FM ENC ALT
AUDIO SPKR 1 PHONE 1 SPKR 2 PHONE 2
RADAR XPDR 2 ADF
NAVIGATION MARKER NAV 1 NAV 2
AVIONICS MASTER
LANDING LIGHTS LH RH AUTOPILOT YAW DAMP TEMP CONTROL RADAR ALT
LIP ANTI-ICE LH RH INVERTER PWR NO. 1 NO. 2 FLAP MOTOR ALT ALERT
VENT BLOWER POWER DIRECTIONAL GYRO NO. 1 NO. 2 IGNITORS LH RH
LDG GEAR POWER SUBPANEL FEEDER LH RH ADI
TORQUE METER LH RH FUEL PRESS FUEL FLOW INVERTER RELAY AVIONICS
AP011653

Figure 2-18. Typical Circuit Breaker and Fuse Panels

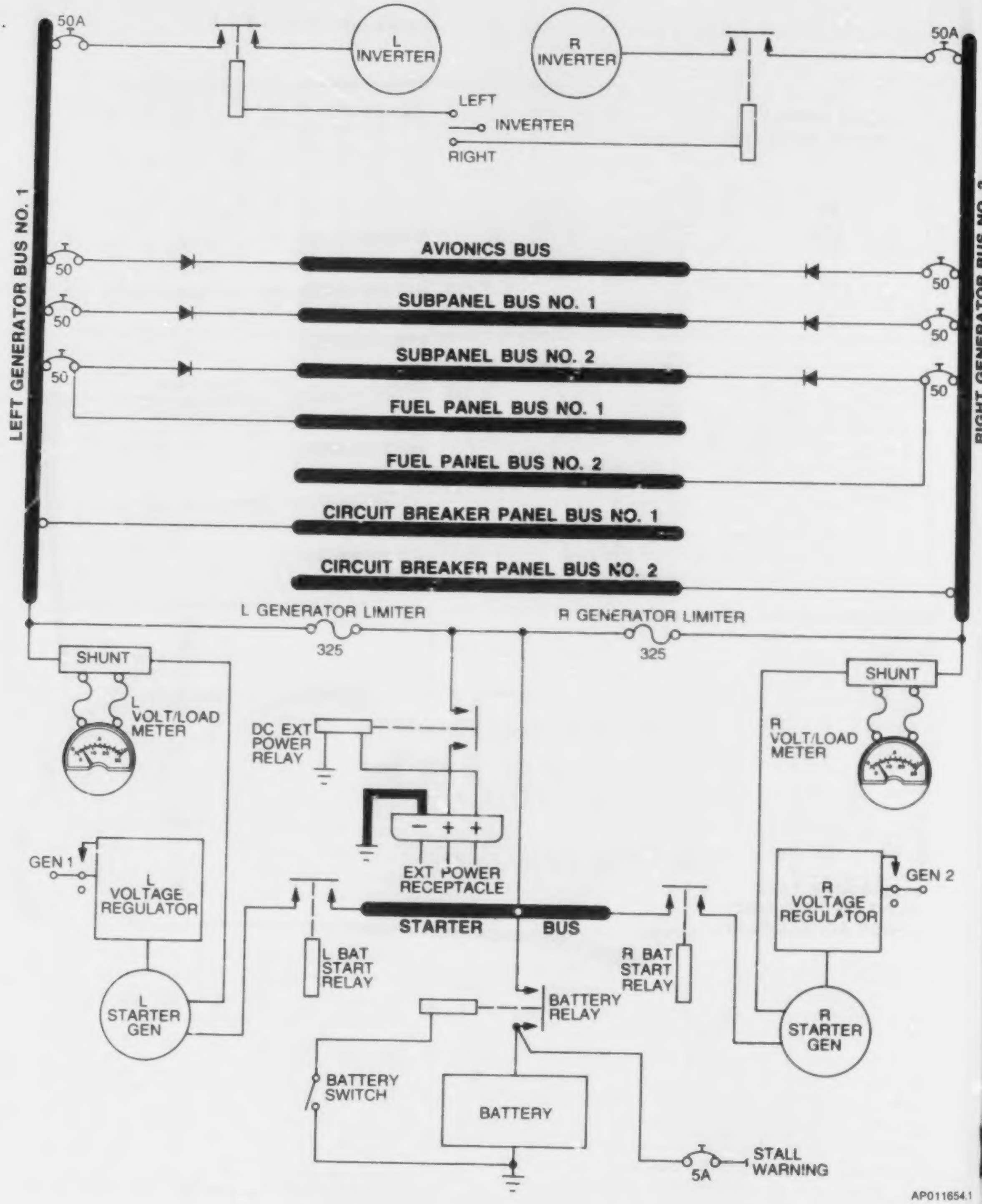

50A
L INVERTER
R INVERTER
50A
LEFT
INVERTER
RIGHT
LEFT GENERATOR BUS NO. 1
RIGHT GENERATOR BUS NO. 2
AVIONICS BUS
SUBPANEL BUS NO. 1
SUBPANEL BUS NO. 2
FUEL PANEL BUS NO. 1
FUEL PANEL BUS NO. 2
CIRCUIT BREAKER PANEL BUS NO. 1
CIRCUIT BREAKER PANEL BUS NO. 2
50
50
50
50
50
50
L GENERATOR LIMITER
R GENERATOR LIMITER
325
325
SHUNT
SHUNT
L VOLT/LOAD METER
R VOLT/LOAD METER
DC EXT POWER RELAY
− + +
EXT POWER RECEPTACLE
GEN 1
L VOLTAGE REGULATOR
GEN 2
R VOLTAGE REGULATOR
STARTER BUS
L BAT START RELAY
R BAT START RELAY
BATTERY RELAY
L STARTER GEN
R STARTER GEN
BATTERY SWITCH
BATTERY
5A
STALL WARNING
AP011654.1

Figure 2-19. Typical Electrical System Schematic (sheet 1 of 3)

AVIONICS BUS

- VHF #1 & #2
- NAV #1 & #2
- ADF
- UHF
- XPDR #1
- ENC ALT
- HF
- XPDR-IFF
- AUDIO #1 & #2 (PHONE)
- TELEPHONE
- MARKER BEACON
- WX RADAR
- FM
- DME
- RMI #1 & #2
- AUDIO #1 & #2 (SPEAKERS)
- CABIN AUDIO (PHONE)
- RADAR ALT
- ALT ALERT
- DIRECTIONAL GYRO #2
- AUTOPILOT
- AVIONICS FANS
- ELEC TRIM
- HDG FLAG

SUBPANEL BUS NO. 1

- GYRO INST LIGHTS
- CABIN LIGHTS
- FLT INST LIGHTS
- ENGINE INST LIGHTS
- TAXI LIGHTS
- NAV LIGHTS
- L PITOT HEAT
- L FUEL CONTROL HEAT
- L ENG LIP BOOT HEAT
- L FUEL VENT
- LANDING GEAR RELAY
- SURFACE DE-ICE
- FIRE WARNING POWER
- WINDSHIELD WIPER
- STALL WARN HORN
- COCKPIT CIGARETTE LIGHTER
- R START CONTROL
- LDG WARNING HORN
- LDG INDICATOR
- ANNUNCIATOR PANEL
- PROP FEATHER
- CHIP DETECTOR
- PILOT WSHLD ANTI-ICE POWER
- PILOT WSHLD ANTI-ICE CONTROL

SUBPANEL BUS NO. 2

- ICE LIGHT
- BEACON
- INST INDIRECT LIGHTS
- CONTROL PANEL LIGHTS
- OVHD LIGHTS
- R SIDE PANEL LIGHTS
- PROP HEAT
- R FUEL CONTROL HEAT
- R ENG LIP BOOT HEAT
- R FUEL VENT HEAT
- BATTERY VENT HEAT
- PROP GOV IDLE STOP
- I & SL INDICATOR
- FLAP INDICATOR
- OIL TEMP INDICATOR
- CROSSFEED VALVE
- FUEL QTY SYSTEM
- L START CONTROL
- C P WSHLD ANTI-ICE POWER
- C P WSHLD ANTI-ICE CONTROL

FUEL PANEL BUS NO. 1

- L FUEL TRANSFER
- L FUEL BOOST PUMP
- L FIREWALL VALVE

FUEL PANEL BUS NO. 2

- R FUEL TRANSFER
- R FUEL BOOST PUMP
- R FIREWALL VALVE

CIRCUIT BREAKER PANEL BUS NO. 1

- L LIP ANTI-ICE
- L LANDING LIGHT
- VENT BLOWER POWER
- LANDING GEAR POWER
- L INVERTER CONTROL
- L IGNITORS

CIRCUIT BREAKER PANEL BUS NO. 2

- R LIP ANTI-ICE
- R LANDING LIGHT
- TEMP CONTROL
- FLAP MOTOR POWER
- R INVERTER CONTROL
- R IGNITORS

AP011654.2

Figure 2-19. Typical Electrical System Schematic (sheet 2 of 3)

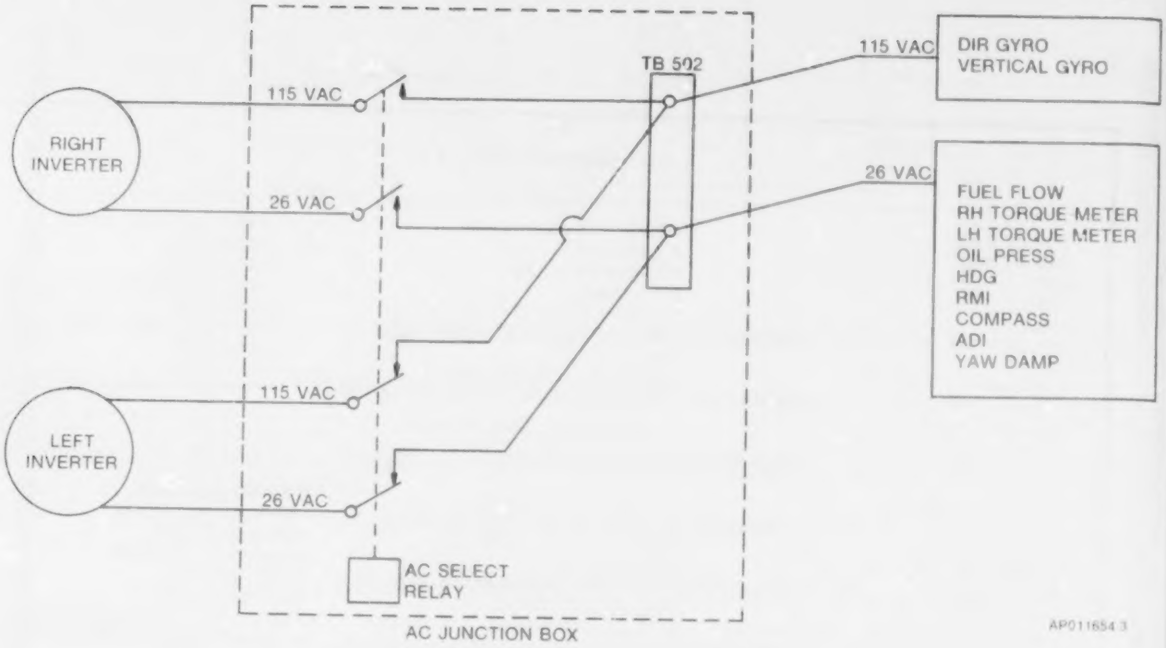


Figure 2-19. Typical Electrical System Schematic (sheet 3 of 3)

continuously illuminated fault lights: RADIO AC OUT, GYRO AC OUT and ENG INST OUT.

b. Inverter Control Switch. One three-position toggle switch on the left subpanel controls the selection of an aircraft inverter source. This switch is placarded INVERTER, LEFT, OFF and RIGHT (fig. 2-7). Neither inverter is a preferred unit, allowing the pilot free choice to select either unit. If an inverter fails in service, power may be restored by selecting the alternate unit.

NOTE

When inverters are switched, the magnetic compass will be affected.

c. Inverter Control Circuit Breakers. Inverter control relay circuits are protected by two 1-ampere circuit breakers placarded INVERTER RELAY NO 1 and NO 2, located on the copilot's circuit breaker panel (fig. 2-18).

SECTION X. LIGHTING.

2-70. Exterior Lighting.

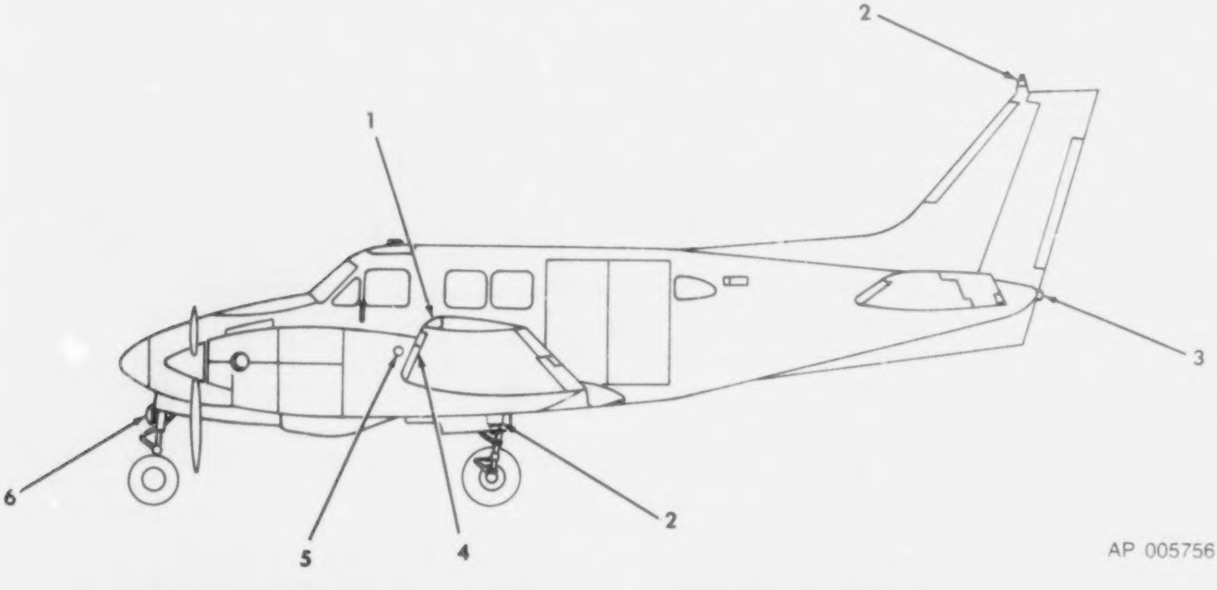
a. Description. Exterior lighting (fig. 2-20) consists of conventional navigation lights on the tail section and on each wing tip, an anti-collision light (STROBE BEACON) on the vertical stabilizer and the underside of the fuselage center section, a single taxi light mounted on the nose landing gear strut, dual landing lights flush mounted in each wing leading edge near the wing tips, and two ice lights, one light flush mounted in each nacelle, positioned to illuminate along the outboard wing leading edge. All exterior lights except the STROBE BEACONS are controlled by individual two-position circuit breaker switches on the left subpanel.

b. Exterior Lighting Circuit Breakers and Switches. The navigation lights are controlled by a 5-ampere circuit breaker switch, placarded NAV, on the left subpanel (fig. 2-7). The taxi light is controlled by a 15-ampere circuit breaker switch, placarded TAXI, on the left subpanel (fig. 2-7). The landing lights for each wing are controlled by individual circuit breaker switches, placarded LANDING LIGHTS, on the left subpanel (fig. 2-7). Both landing lights have redundant circuit protection. Each light switch has a internal 20-ampere circuit breaker element which is in series with a respective 20-ampere circuit breaker, placarded LANDING LIGHTS-LH-RH, located on the copilot's circuit breaker and fuse panel (fig. 2-18). The STROBE BEACON lights are protected by a 15-ampere push-pull circuit breaker placarded BEACON, on the left subpanel (fig. 2-7). The STROBE BEACON control and select switches are located on the control pedestal placarded STROBE BEACON (fig. 2-6). The two ice lights are controlled by a 5-ampere circuit breaker switch, placarded ICE, on the left subpanel (fig. 2-18). Placing any of the control switches ON completes the circuit to the associated light. In the event of circuit overload, the circuit breaker portion of the affected switch will disconnect the circuit from power and the switch toggle arm will drop back to the OFF position. Repositioning a switch toggle on the ON position will reset the circuit breaker. In the event the beacon circuit is overloaded, the push-pull circuit breaker will pop out. To reset the circuit breaker, push in.

2-71. Interior Lighting.

Instrument panel lighting is provided by individual post or eyebrow type red lights installed at the top edge of each instrument. In addition, instrument indirect lighting is provided by nine white lamps and nine red lamps located in the glareshield overhang along the top edge of the instrument panel. Additional cockpit lighting is furnished by two white flood lights flush mounted in the overhead light control panel, and a cockpit utility light mounted on the window ledge on each side of the cockpit. Two overhead white flood lights are installed in the cabin area. All aircraft interior lighting is controlled by either rheostat, press-to-light, or toggle type switches located on the overhead control panel (fig. 2-21) in the cockpit. All switches are appropriately placarded as to their identity and function position.

a. Interior Lighting Circuit Breakers. Interior lighting circuits are protected by eight 5-ampere circuit breakers on the right subpanel under the group placarded LIGHTS (fig. 2-18). The circuit breaker ENG INST protects the engine instrument and radio panel light circuits. The FLT INST circuit breaker protects the magnetic compass, flight instruments, oxygen quantity indicator, deice pressure gage, and the free air temperature light circuits. The CABIN circuit breaker protects the reading light circuits of the cabin. The GYRO INST circuit breaker protects pilot gyro instrument lights. The RH SIDE PANEL circuit breaker protects lighting circuits for the copilot's circuit breaker and fuse panel. The OVHD circuit breaker protects the overhead control panel edge, the map light, cockpit red lights and fuel panel edge light circuits. The CONTROL PANEL



1. Wing tip navigation light (typical both wings)
2. Anti-collision lights (strobe beacon)
3. Tail navigation light
4. Dual landing lights (typical both wings)
5. Ice light(typical both nacelles)
6. Taxi light

Figure 2-20. Exterior Lighting

circuit breaker protects the subpanel edge, pedestal edge, and instrument light circuits.

b. Interior Lighting Controls. Two white flood lights are integrally mounted on the bottom part of the overhead control panel (fig. 2-21). These flood lights are controlled by a rheostat switch, placarded OVERHEAD FLOOD LIGHTS, located on the overhead control panel. The overhead panel flood lights are protected by a 5-ampere circuit breaker, placarded OVHD, on the right subpanel (fig. 2-18).

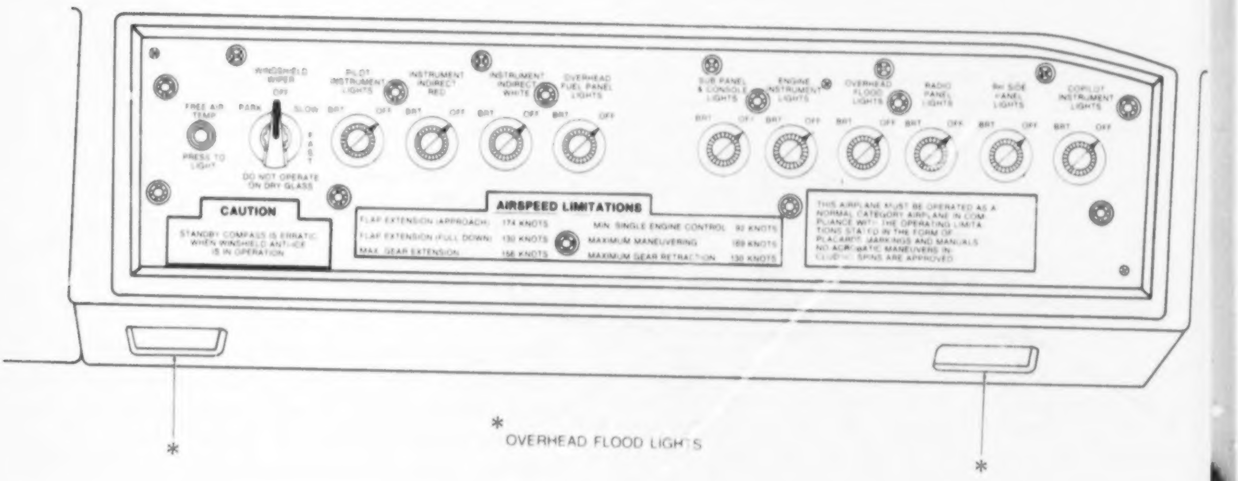
c. Free Air Temperature Light. The free air temperature light is mounted overhead in the cockpit adjacent to the free air temperature gage. The light is operated by the push-button switch, placarded FREE AIR TEMP-PRESS TO LIGHT (fig. 2-21), to illuminate the face of the gage. The light is protected by a 5-ampere circuit breaker on the right subpanel placarded FLT INST (fig. 2-18). The free air temperature light is similar in construction to the instrument post lights.

d. Magnetic Compass Light. The magnetic compass light, above the face of the compass, makes the compass card readable. This light is controlled by a rheostat-switch, placarded PILOT INSTRUMENT LIGHTS - BRT, OFF, located on the overhead control panel (fig. 2-21). This light is protected by a 5-ampere circuit breaker, placarded FLT INST, on the right subpanel (fig. 2-18).

e. Subpanels and Copilot's Circuit Breaker Panel Edge Lighting. The plastic cover panels on the bus panels and the copilot's circuit breaker panel are illuminated by edge lights. The edge-light socket is recessed into the plastic panel. The cap assembly, which contains a red filter, screws down against the plastic panel. The edge lights on the subpanels are controlled by a rheostat-switch, placarded SUBPANEL & CONSOLE LIGHTS, on the overhead control panel (fig. 2-21). Edge light circuits receive power from a 5-ampere circuit breaker, placarded CONTROL PANEL, located on the right subpanel (fig. 2-18).

f. Cabin Lights. The cabin is provided with six overhead lights controlled by a rheostat switch mounted in the ceiling adjacent to each light. These lights are protected by a 5-ampere circuit breaker, placarded CABIN, on the right subpanel (fig. 2-18).

g. Normal Operation of Interior Lights. All lights controlled from the overhead control panel are turned ON and OFF, and adjusted for brightness by rotating the rheostat controls. The initial clockwise rotation of any rheostat knob on the overhead control panel will turn ON the affected lighting circuit to dimmest illumination level. Further clockwise


WINDSHIELD WIPER
OFF
PARK
SLOW
FAST
DO NOT OPERATE ON DRY GLASS
FREE AIR TEMP
PRESS TO LIGHT
PILOT INSTRUMENT LIGHTS
INSTRUMENT INDIRECT RED
INSTRUMENT INDIRECT WHITE
OVERHEAD FUEL PANEL LIGHTS
SUB PANEL & CONSOLE LIGHTS
ENGINE INSTRUMENT LIGHTS
OVERHEAD FLOOD LIGHTS
RADIO PANEL LIGHTS
RH SIDE PANEL LIGHTS
COPILOT INSTRUMENT LIGHTS
BRT
OFF
CAUTION
STANDBY COMPASS IS ERRATIC WHEN WINSHIELD ANTI-ICE IS IN OPERATION
AIRSPEED LIMITATIONS
FLAP EXTENSION (APPROACH) 174 KNOTS
FLAP EXTENSION (FULL DOWN) 130 KNOTS
MAX. GEAR EXTENSION 156 KNOTS
MIN. SINGLE ENGINE CONTROL 92 KNOTS
MAXIMUM MANEUVERING 169 KNOTS
MAXIMUM GEAR RETRACTION 130 KNOTS
THIS AIRPLANE MUST BE OPERATED AS A NORMAL CATEGORY AIRPLANE IN COMPLIANCE WITH THE OPERATING LIMITATIONS STATED IN THE FORM OF PLACARDS, MARKINGS AND MANUALS. NO ACROBATIC MANEUVERS IN- CLUDING SPINS ARE APPROVED
*
*
* OVERHEAD FLOOD LIGHTS

AP013666

Figure 2-21. Overhead Control Panel

rotation progressively increases the brilliance of the lights. The passenger-controlled lights are energized by the switches mounted integrally with the lights.

SECTION XI. FLIGHT INSTRUMENTS

2-72. Airspeed Indicators.

Two airspeed indicators are installed separately on the pilot and copilot sides of the instrument panel (fig. 2-22). The indicator dials are calibrated in knots from 40 to 260.

2-73. Turn-And-Bank Indicators.

Two turn-and-bank indicators are installed separately on the pilot and copilot sides of the instrument panel (fig. 2-22). These indicators are gyroscopically operated. The pilot unit is operated by DC power and is protected by a 5-ampere circuit breaker, placarded T & B IND, on the right subpanel (fig. 2-7). The copilot's indicator is driven by the aircraft pneumatic system.

2-74. Pilot's Encoding Altimeter.

The pilot's altimeter is located on the upper left side of the instrument panel (fig. 2-22). Altitude is displayed on the pilot's altimeter by a 10,000 foot counter, a 1,000 foot counter, and a single needle pointer. Below an altitude of 10,000 feet, black and white cross-hatching will appear on the 10,000 foot counter. A barometric pressure setting knob is provided to insert the desired altimeter setting. The altimeter contains dual baroscales which permits barometric pressure setting in both millibars and inches of mercury (Hg). A red and white striped warning flag will cover the digital altitude indicator if DC power is lost. The encoding altimeter is protected by a 1-ampere circuit breaker, placarded ENC ALT, located on the right subpanel (fig. 2-18).

2-75. Copilot's Altimeter.

a. Copilot's Altimeter. The copilot's altimeter is located on the upper right side of the instrument panel (fig. 2-22). Either one of the following altimeters may be installed.

(1) Encoding Altimeter. The altimeter is a self-contained unit which consists of a sensitive pressure altimeter combined with an altitude encoder. The display indicates and the encoder transmits, simultaneously, pressure altitude reporting. Altitude is displayed on the altimeter by a 10, 000 foot counter, a 1,000 foot counter, and a single needle pointer which indicates hundreds of feet on a circular scale in 50 foot increments. Below an altitude of 10,000 feet, a diagonal warning symbol will appear on the 10,000 foot counter. A barometric pressure setting knob is provided to insert the desired altimeter setting in inches of Hg. A DC powered vibrator operates inside the altimeter whenever aircraft power is on. If DC power to the altitude encoder is lost, a warning flag placarded CODE OFF will appear in the upper left portion of the instrument face, indicating that the altitude encoder is inoperative, and that the system is not reporting altitude to ground stations.

(2) Barometric Altimeter The barometric altimeter, displays altitude in hundreds of feet by a long pointer, in thousands of feet by a second pointer, and in ten-thousands of feet by a disc mounted pointer. A barometric pressure setting knob is provided to insert the desired altimeter setting in inches Hg. This unit requires no electrical power for operation.

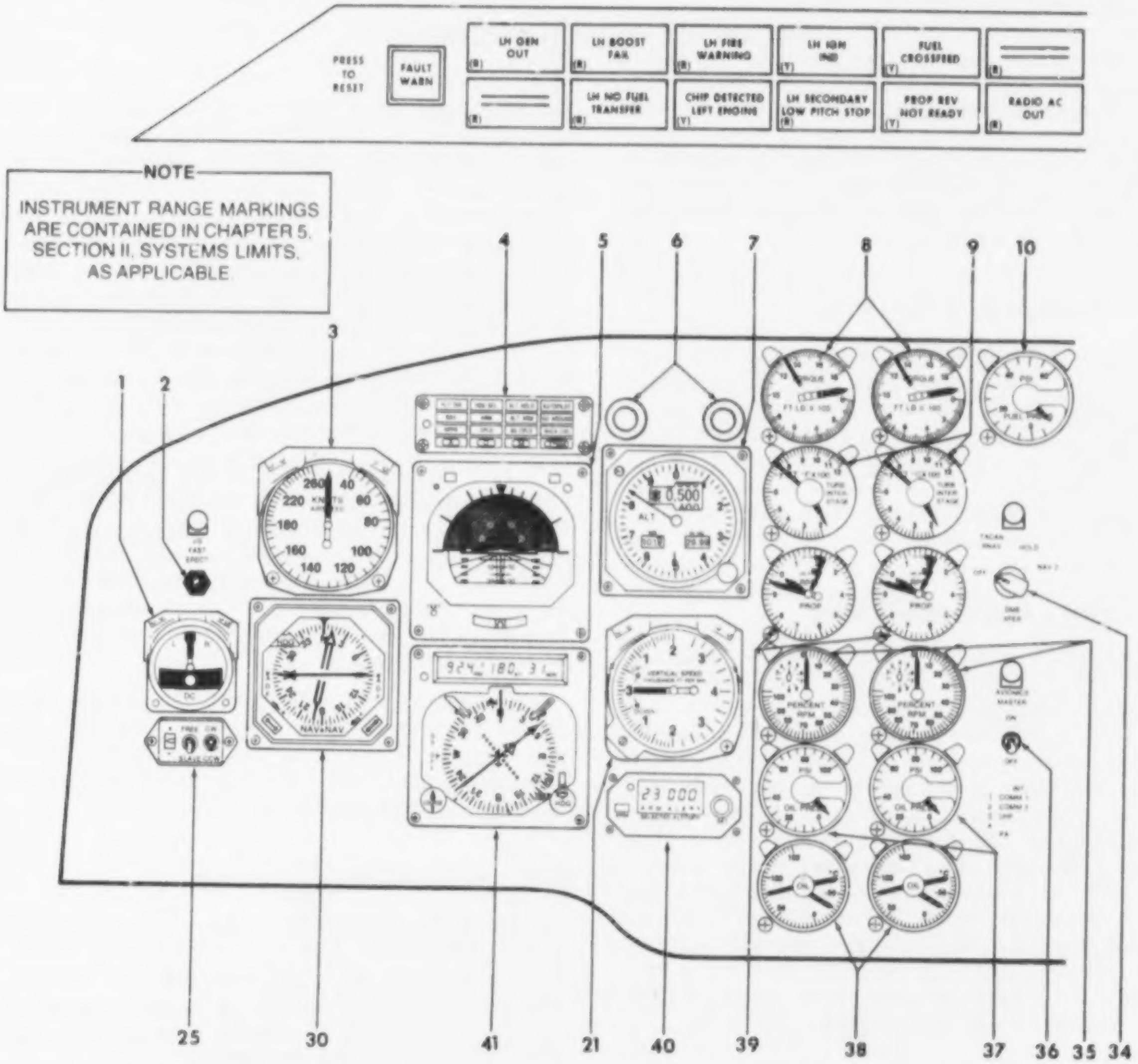
An alternate unit may be installed which is similar in appearance to the encoding altimeter. This unit requires DC power for proper operation. It does not contain the CODE OFF flag, and does not have altitude encoding capability.

2-76. Vertical Velocity Indicators.

Two vertical velocity indicators are installed separately on the pilot and copilot sides of the instrument panel (fig. 2-22). They indicate the speed at which the aircraft ascends or descends based on changes in atmospheric pressure. The indicator is a direct reading pressure instrument.

2-77. Pilot's Flight Director Indicator.

The pilot's flight director indicator (FDI) (fig. 3-10) combines the attitude sphere display with computed steering information to provide the commands required to intercept and maintain a desired flight path. All guidance commands are depicted through the use of a command V-bar arrangement. Warning flags are provided to indicate invalid attitude or computed command displays. Any warning flag in view indicates that that portion of information is unreliable. An inclinometer, located on the


PRESS TO RESET
FAULT WARN
LH GEN OUT (R)
LH BOOST FAIL (R)
LH FIRE WARNING (R)
LH IGN IND (Y)
FUEL CROSSFEED (Y)
(R)
(R)
LH NO FUEL TRANSFER (R)
CHIP DETECTED LEFT ENGINE (Y)
LH SECONDARY LOW PITCH STOP (R)
PROP REV NOT READY (Y)
RADIO AC OUT (R)
1
2
3
4
5
6
7
8
9
10
25
30
41
21
40
39
38
37
36
35
34
KNOTS
ALT
TORQUE
PROP
PERCENT RPM
OIL PRESS
FUEL PRESS
NAV/NAV
DC
23 000
AVIONICS MASTER
ON
OFF

NOTE

INSTRUMENT RANGE MARKINGS ARE CONTAINED IN CHAPTER 5, SECTION II, SYSTEMS LIMITS, AS APPLICABLE.

1. Turn-and-bank indicator (electric)
2. Vertical gyro fast erect switch
3. Airspeed indicators
4. Flight director mode annunciator panel
5. Flight director indicator
6. Propeller autofeather arm annunciators
7. Encoding altimeter
8. Torquemeters
9. ITT gages
10. Fuel pressure gages
11. NAV 1 control panel
12. COMM 1 control panel
13. Fuel flow gages
14. Instrument air pressure gage
15. COMM 2 control panel
16. Battery charge light
17. Cabin heat out light
18. NAV 2 control panel
19. Marker beacon receiver
20. Attitude indicator
21. Vertical speed indicators

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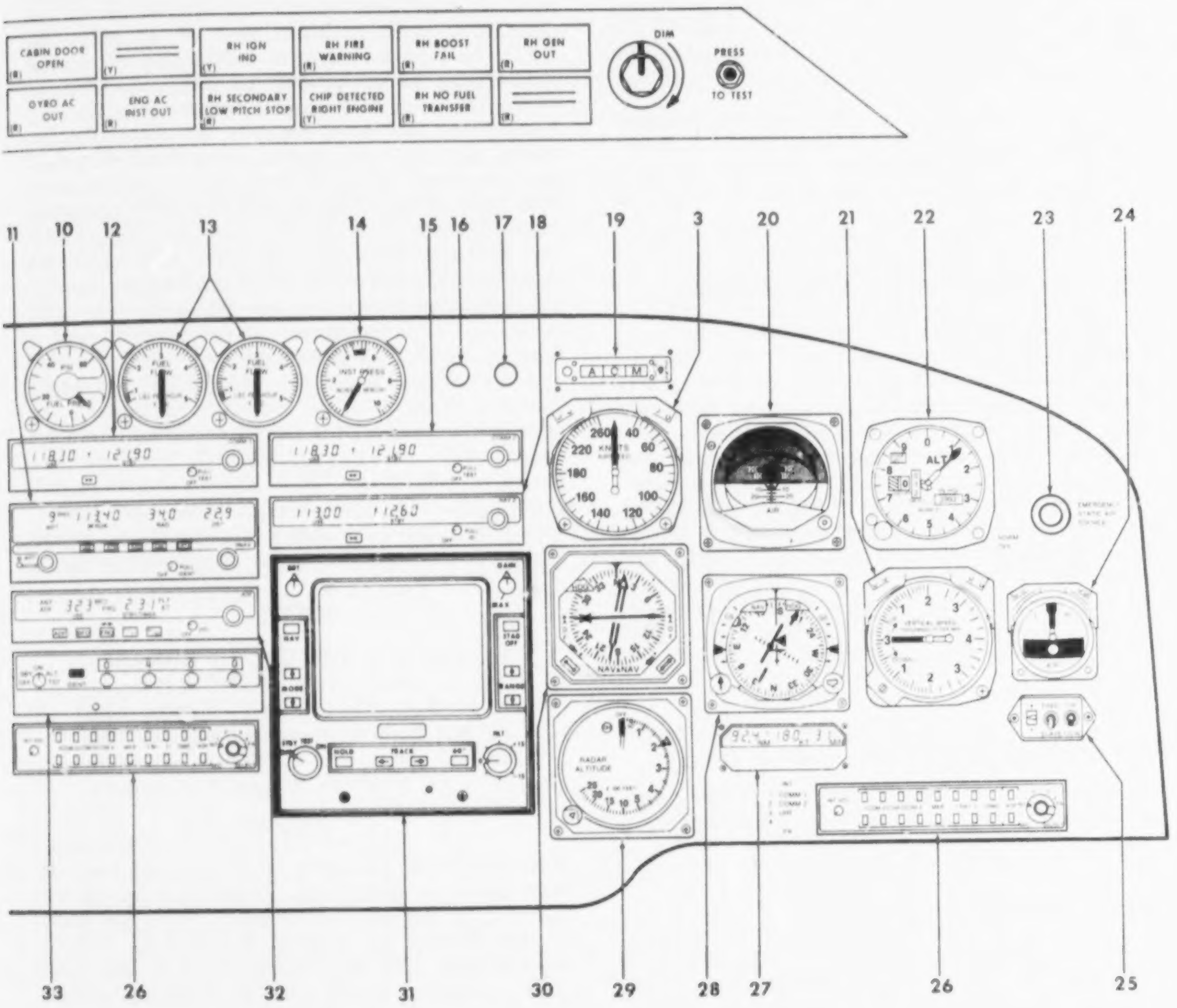
Figure 2-22. Typical Instrument Panel (sheet 1 of 2)


CABIN DOOR OPEN
RH IGN IND
RH FIRE WARNING
RH BOOST FAIL
RH GEN OUT
GYRO AC OUT
ENG AC INST OUT
RH SECONDARY LOW PITCH STOP
CHIP DETECTED RIGHT ENGINE
RH NO FUEL TRANSFER
DIM
PRESS TO TEST
11
10
12
13
14
15
16
17
18
19
3
20
21
22
23
24
FUEL FLOW
INST PRESS
A C M
KNOTS
ALT
NAV NAV
RADAR ALTITUDE
HOLD
TRACK
33
26
32
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22. Altimeter
23. Emergency static air control
24. Turn-and-bank indicator (air)
25. Slave control units
26. Audio control panels
27. DME indicator
28. Copilot's horizontal situation indicator
29. Radar altimeter
30. Radio magnetic indicators
31. Weather radar
32. ADF control panel
33. Transponder control panel
34. DME transfer switch
35. Turbine tachometers
36. Avionics master switch
37. Oil pressure gages
38. Oil temperature gages
39. Propeller tachometers
40. Altitude select controller
41. Pilot's horizontal situation indicator

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Figure 2-22. Typical Instrument Panel (sheet 2 of 2)

bottom of the indicator, provides th pilot a conventional display of aircraft slip or skid.

a. Fast Erect Switch. A switch placarded V/G FAST ERECT, located on the pilot's side of the instrument panel, provides for fast erection of the FDI attitude sphere.

b. External Torque and Fast Erect Switches. Two switches, EXTERNAL TORQUE/NO. 1 FAST ERECT and EXTERNAL TORQUE/NO. 2 test of the vertical gyros for the attitude indicators (fig. 2-22). Refer to chapter 3.

2-78. Copilot's Attitude Director Indicator.

The copilots attitude director (ADI) (fig. 3-11) displays aircraft attitude as a conventional pneumatic operated attitude gyro. Attitude displayed is in relationship to an artificial horizon. An indicating plane in front of the face of the instrument represents the aircraft and a movable horizontal bar behind the indicating plane represents the horizon. The symbolic aircraft may be adjusted vertically by means of a knob located on the indicator, to correct for variations in level flight attitude at different airspeeds. This unit is designed to operate through all attitudes and need not be caged for any maneuver. The ADI is equipped with a decision height (DH) annunciator, which works in conjunction with the radar altimeter.

2-79. Free Air Temperature Gage.

The free air temperature gage, centered above the windshield (fig. 2-5), indicates the outside air temperature in degrees celsius.

2-80. Magnetic Compass.

The magnetic compass is located on the top of the windshield diider. A compass correction chart indicating deviation is located adjacenta to the magnet compass.

2-81. Radio Magnetic Indicators (RMI).

Identical radio magnetic indicators are installed for the pilot and copilot (fig. 3-6). Each RMI provides aircraft heading and radio bearing information, to-from a VOR, ADF facility or RNAV waypoint. A selector switch on the RMI provides for selection of either ADF as the bearing information to be displayed by either needle. Slave control units located on the pilot and copilot side of the instrument panel (fig. 2-22) controls the RMI gyro slaving circuit. Refer to chapter 3.

2-82. Miscellaneous Instruments.

a. Annunciator Panels. The annunciator panel is positioned across the glareshield of the instrument panel in direct view of the pilot (fig. 2-22). This panel provides monitoring of critical functions of the aircraft and indicates conditions for which the pilot must take appropriate action. In frontal view this panel presents two rows of small, rectangular windows (lights) some colored yellow and some colored red. Illumination of a red warning light signifies the existence of a hazardous condition requiring immediate corrective action. A yellow caution light signifies a condition other than hazardous requiring pilot attention. Word-printing on individual lights identifies the monitored function or fault condition. Active elements of the panel include a flashing FAULT WARN light, individual function and fault lights, and DIM and PRESS TO TEST controls. When a "fault" condition is present, the appropriate annunciator legend window illuminates continuously, and the red FAULT WARN button flashes on and off. All "fault" legends illuminate red, except for the CHIP DETECTED fault legend, which illuminates yellow. Each "function" legend illuminates yellow during the designated function.

NOTE

The FAULT WARN light will flash whenever the yellow CHIP DETECTED legend illuminates. The FAULT WARN light will not flash or illuminate when the red RADIO AC OUT, GYRO AC OUT or ENG AC INST OUT legends illuminate.

(1) Fault warning light. If a fault should occur, (example: LH GEN OUT) a signal from the fault sensor is sent to its respective light (in this case: red) in the annunciator panel. A parallel signal is also directed to activate the flashing FAULT WARN light. This light will continue to flash after fault correction unless reset by pressing its face. Reset will extinguish the light; however, a second fault will cause it to illuminate again.

(2) Indicating function. If an indicating function should occur, (example: LH IGN IND), a signal from the indicator sensor is sent to its respective circuit in the same manner as a fault signal. However, an indicating function will not cause the FAULT WARN light to flash.

(3) Dimming control. The intensity of all lights in the annunciator panel are dimmed by a common DIM control (fig. 2-22). When a signal is sent to the panel, the affected light illuminates at maximum brightness. When the FAULT WARN light is reset, the lights will dim to the level set by

the DIM control. Dimming cannot be accomplished until after reset. Circuits of the annunciator panel are protected by a 5-ampere circuit breaker, placarded ANN PANEL, on the right subpanel.

b. Other Instruments. Other instruments not previously described include an electrically operated digital clock located on each control wheel, and an instrument pressure gage located on the instrument panel (fig. 2-22).

SECTION XII. SERVICING, PARKING, AND MOORING

2-83. General.

The following paragraphs include the procedures necessary to service the aircraft, except lubrication (fig. 2-23). The lubrication requirements of the aircraft are covered in TM 55-1510-209-20/1. Refer to tables 2-3, 2-4, 2-5, and 2-6, for identification of fuel, oil, etc. used to service the aircraft. The servicing instructions provide procedures and precautions necessary to service the aircraft.

2-84. Servicing Fuel System.

The fuel system is made up of a 57 gallon (370.5 pounds) nacelle tank and wing tank fuel cells of 128 gallons (832 pounds) capacity, making a total fuel capacity of 370 gallons (2,405 pounds).

NOTE

Service the fuel tanks after each flight to keep the bladder type cells from drying out.

NOTE

At least thirty minutes after servicing the tanks, open the sump drains and fuel strainer drains and allow a small amount of fuel to drain from each of these points.

NOTE

Settling time for AVGAS is 15 minutes per foot of tank depth and one hour per foot depth for jet (JP) fuels. Allow the fuel to settle for the prescribed period before any fuel samples are taken.

a. Fuel Handling Precautions. While handling fuel it is well to remember that even through the aircraft uses JP-4 (primary) and JP-5 (alternate) as its principal fuel, it may be operated on aviation gasoline as an emergency fuel.

WARNING

When aviation gasoline is used in a turbine engine, extreme caution should be used when around the combustion chamber and exhaust area to avoid cuts or abrasions. The exhaust deposits contain led oxide which will cause lead poisoning.

CAUTION

Proper procedures for handling JP-4 and JP-5 fuel cannot be over stressed. Clean, fresh fuel must be used and the entrance of water into the fuel storage or aircraft fuel system must be kept to a minimum.

CAUTION

When conditions permit, the aircraft should be positioned so that the wind will carry the fuel vapors away from all possible sources of ignition. The fuel vehicle shall be positioned to maintain a minimum distance of 10 feet from any part of the aircraft, while maintaining a minimum distance of 20 feet between the fueling vehicle and the fuel filler point.

NOTE

The use of aviation gasoline as an emergency fuel is permitted for a period of not more than 150 hours during time between engine overhauls (TBO). A mixture of more than 10% aviation gasoline shall be entered on DA Form 2408-13. The lowest octane aviation gasoline available is recommended to avoid build up of deposits on turbine blades.

(1) Shut off all electrical equipment on the aircraft, including radar and radar equipment. The master switch may be left on, but is must not be

moved during the fueling operation. Do not allow operation of any electrical tools, such as drills or buffers, in or near the aircraft during fueling.

(2) Refuel aircraft as soon as possible after landing.

(3) Keep fuel servicing nozzles free of snow, water, and mud at all times.

WARNING

Prior to opening the fuel tank filler, the hose nozzle static ground wire must be attached to the grounding lugs that are located adjacent to filler openings.

(4) Carefully remove snow, water, and ice from the aircraft fuel filler cap area before removing the fuel filler cap. Remove only one aircraft tank filler cap at any one time, and replace each one immediately after the servicing operation is completed.

(5) Wipe all frost from fuel filler necks before servicing.

(6) Drain water from fuel tanks, filter cases, and pumps at least 30 minutes after each servicing, at least 30 minutes after each removal from heated shelter, and before each flight. Preheat, when required, to insure free fuel drainage.

(7) Insofar as possible, leave only fully serviced aircraft outside.

(8) Avoid dragging the fueling hose where it can damage the soft, flexible surface of the deicer boots.

(9) Insure that the aircraft and components being serviced are securely coupled to a low resistance ground. Connect the static ground cable and the fueler to a grounding stake. When engaged in the fueling operation, discharge the static electricity accumulated by the body and clothing by touching the ground cable or stake before each operation.

(10) Observe NO SMOKING precautions.

(11) Prior to transferring the fuel, insure that the hose is grounded to the aircraft.

(12) Wash off spilled fuel immediately.

(13) Handle the fuel hose and nozzle cautiously to avoid damaging the wing skin.

(14) Do not conduct fueling operations within 100 feet of energized airborne radar equipment or within 300 feet of energized ground radar equipment installations.

(15) Wear only nonsparking shoes near aircraft or fueling equipment, as shoes with nailed soles or metal heel plates can be a source of sparks.

b. Fuel Handling Precautions For Extreme Weather Conditions. When fueling is conducted on ice or on sandy or desert terrain, or when a satisfactory ground cannot be secured, additional precautions must be taken to avoid the buildup of static electricity. Refer to TM 55-410. Since draining the static charges is not possible without an adequate ground, reliance must be placed on equalizing the potentials in order to prevent a dangerous sparkling discharge as in the following bonding procedure:

(1) Connect ground cable from fuel servicing unit to satisfactory ground, such as a grounding post.

(2) Connect grounding cable to some convenient unpainted metal part of aircraft, excluding propellers or antennas.

(3) Connect bonding cable from aircraft to fuel servicing unit. A conductive-type fuel hose is not a satisfactory method of bonding.

(4) Connect bonding cable from fuel nozzle to aircraft before fuel tank cover is opened.

(5) When disconnecting, reverse the order of steps 1 through 4.

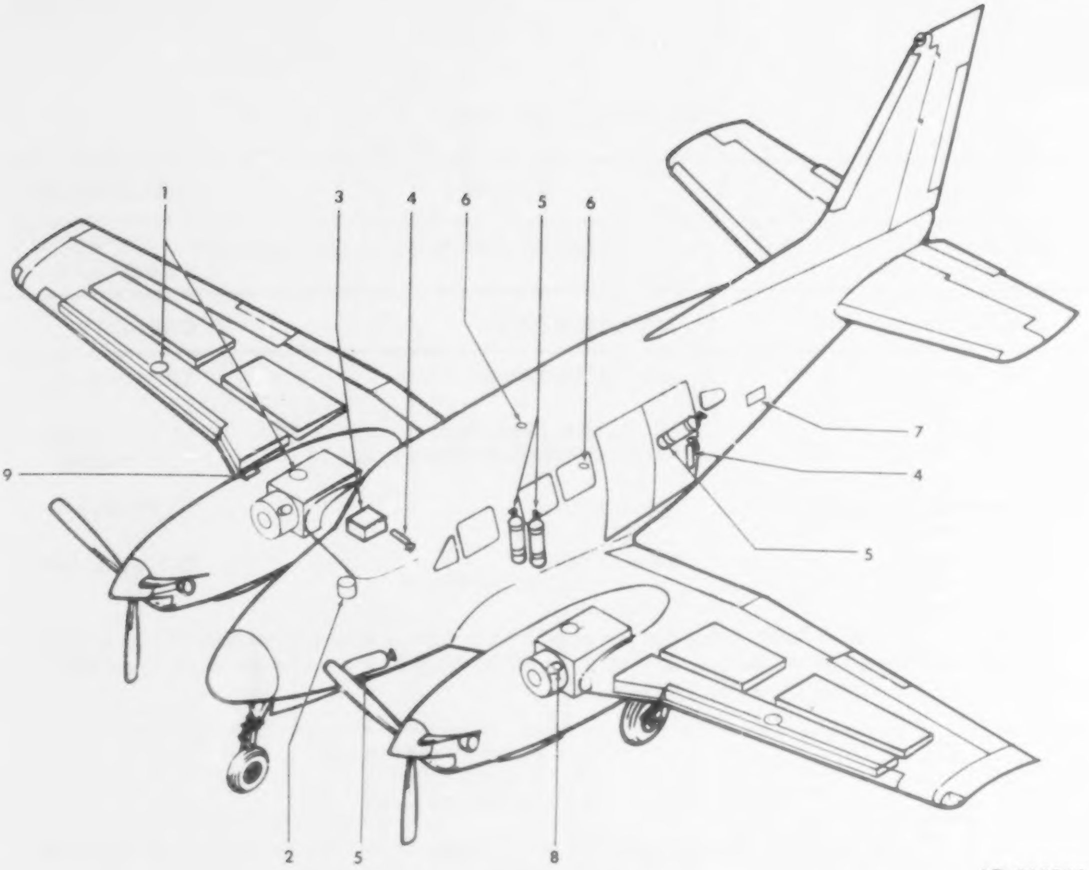
c. Blending Anti-icing Additives to Fuel.

CAUTION

Insure that the additive is directed into the flowing fuel stream; start additive flow after fuel flow starts, and stop before fuel flow stops. Do not allow concentrated additive to contact coated interior of fuel cells or aircraft painted surfaces. Use not less than 20 fl oz of additive per 260 gallons of fuel or more than 20 fl oz of additive per 104 gallons of fuel.

The following procedure is to be used when blending anti-icing additive (which must conform to specification MIL-I-27686) with the fuel as the aircraft is being refueled:

(1) Using "HI-FLO PRIST" blender (Model PHF-204), remove cap containing the tube and clip assembly.



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1. Fuel tank filler caps (typical left and right)
   Fuel: spec. MIL-T-5624 (JP-4 or JP-5)

2. Wheel brake fluid reservoir
   Hydraulic fluid: spec. MIL-H-5606

3. Battery

4. Fire extinguisher, hand type CF_3Br.

5. Oxygen supply cylinders
   Breathing oxygen: spec. MIL-O-27210

6. Ferry fuel tank filler caps (2)

7. Oxygen filler valve

8. Engine oil filler caps (typical left and right)
   Engine oil: spec. MIL-L-7808, synthetic base, −40°F (−40°C)
   Engine oil: spec. MIL-L-23699, synthetic base, ABOVE −40°F (−40°C)

9. External power receptacle (24 volt)

Figure 2-23. Servicing Locations

Table 2-3. Fuels, Lubrication Specifications and Capacities

SYSTEM	SPECIFICATION	CAPACITY
Fuel	MIL-T-5624 (JP-4)	373.6 U.S. Gals.
Engine oil	MIL-L-7808 (See Notes 1, 3, and 4) MIL-L-23699 (See Notes 2 and 3)	14 U.S. Quarts per engine
Hydraulic brake system	MIL-H-5606	1 U.S. Pint
Oxygen system	MIL-O-27210	203 Cubic feet

NOTE 1: MIL-L-7808 oil used in the engine oil system is specified for operation in ambient temperatures below −40°C (−40°F). This oil may also be used when MIL-L-23699 oil is not available.

NOTE 2:

CAUTION

Under no circumstances shall MIL-L-23699 oil be used at ambient temperatures below −40°C (−40°F). MIL-L-23699 oil used in engine oil system is authorized and directed for use in ambient temperatures above −40°C (−40°F).

NOTE 3:

CAUTION

Do not mix MIL-L-23699 oil with MIL-L-7808 oil except in case of emergency. If it becomes necessary to mix the oils, the applicable system shall be flushed within six hours and filled with the proper oil.

NOTE 4:

CAUTION

Lubrication oil made to MIL-L-7808 by Shell Oil Company under their part number 307, qualification number 7D-1 shall NOT be used in U-21 series engines.

Table 2-4. Approved Oils

SPECIFICATION	PRODUCT	VENDOR
MIL-L-23699 (5 centistokes)	Esso Turbo Oil 2380	Exxon International Co. New York, NY Toronto, Ontario, Canada
	Exxon Turbo Oil 2380	Exxon Co. Houston, Texas
	Aero Shell Turbine Oil 500	Shell Oil Co. Houston, Texas Toronto, Ontario, Canada
	Stauffer Jet II	Stauffer Co. Westport, CT
	Castrol 5000	United Kingdom

(2) Attach pistol grip on collar.

(3) Press tube into button.

(4) Clip tube end to fuel nozzle.

(5) Pull trigger firmly to insure fuel flow, then lock in place.

(6) Start flow of additive when refueling begins. (Refueling should be at a rate of 30 to 60 gallons per minute. A rate of less than 30 gallons per minute may be used when topping off tanks.)

d. Filling Fuel Tanks. Fill tanks as follows:

(1) Attach bonding cables to aircraft.

(2) Attach bonding cable from hose nozzle to ground socket adjacent to fuel tank being filled.

(3) Always fill nacelle tank before wing tank.

(4) Open applicable fuel tank filler cap.

(5) Fill fuel tank with fuel.

(6) Secure applicable fuel tank filler cap.

CAUTION

Make Make sure fuel filler cap latch tab is pointed aft.

(7) Disconnect bonding cables from aircraft.

e. Filling Ferry Fuel System Tanks. Fill ferry system tanks in accordance with procedures and safety precautions which are used in filling the aircraft's regular fuel tanks. Observe placard on ferry system tanks which reads FERRY TANK CAPACITY 120 U.S. GALLONS FILL TO BOTTOM OF TAB ON FILLER NECK. USE AVIATION KEROSENE OR SEE PILOT–S OPERATING MANUAL FOR ALTERNATES.

f. Draining Moisture From Fuel System. To remove moisture and sediment from the fuel system, 10 fuel drains are installed. The locations are as follows: one outboard of nacelle, one in the main gear wheel well (low point of fuel system), one just ahead of wheel well (to drain boost pumps), one inboard of nacelle (to drain transfer pumps), and one at the inertial separator air bypass duct (to drain fuel filter).

Table 2-5. Approved Fuels

SOURCE	PRIMARY OR STANDARD FUEL	ALTERNATE FUEL	
US Military Fuel	JP-4 (MIL-T-5624)	JP-5 (MIL-T-5624)	
NATO Code No.	F-40 (Wide Cut Type)	F-44 (High Flash Type)	
COMMERICAL FUEL (ASTM-D-1655)	JET B	JET A	JET A-1 NATO F-34
American Oil Co.	American JP-4	American Type A	
Atlantic Richfield	Arcojet B	Arcojet A	Arcojet A-1
Richfield Div.		Richfield A	Richfield A-1
B. P. Trading	B.P.A.T.G.		B.P.A.T.K.
Caltex Petroleum Corp.	Caltex Jet B		Caltex Jet A-1
Cities Service Co.		CITGO A	
Continental Oil Co.	Conoco JP-4	Conoco Jet-50	Conoco Jet-60
Gulf Oil	Gulf Jet B	Gulf Jet A	Gulf Jet A-1
EXXON Co., USA	EXXON Turbo Fuel B	EXXON A	EXXON A-1
Mobil Oil	Mobil Jet B	Mobil Jet A	Mobil Jet A-1
Philips Petroleum	Philjet JP-4	Philjet A-50	
Shell Oil	Aeroshell JP-4	Aeroshell 640	Aeroshell 650
Sinclair		Superjet A	Superjet A-1
Standard Oil Co.		Jet A Kerosene	Jet A-1 Kerosene
Chevron	Chevron B	Chevron A-50	Chevron A-1
Texaco	Texaco Avjet B	Avjet A	Avjet A-1
Union Oil	Union JP-4	76 Turbine Fuel	
FOREIGN FUEL	NATO F-40	NATO F-44	
Belgium	BA-PF2B		
Canada	3GP-22F	3-6P-24e	
Denmark	JP-4 MIL-T-5624		
France	Air 3407A		
Germany (West)	VTL-9130-006	UTL-9130-007/UTL 9130-010	
Greece	JP-4 MIL-T-5624		
Italy	AA-M-C-1421	AMC-143	
Netherlands	JP-4 MIL-T-5624	D. Eng RD 2493	
Norway	JP-4 MIL-T-5624		
Portugal	JP-4 MIL-T-5624		
Turkey	JP-4 MIL-T-5624		
United Kingdom (Britain)	D. Eng RD 2454	D. Eng RD 2498	

NOTE:

Anti-icing and Biocidal Additive for Commercial Turbine Engine Fuel - The fuel system icing inhibitor shall conform to MIL-I-27686. The additive provides anti-icing protection and also functions as a biocide to kill microbial growths in aircraft fuel systems. Icing inhibitor conforming to MIL-I-27686 (PRIST) shall be added to commercial fuel, not containing an icing inhibitor, during refueling operations, regardless of ambient temperatures. Refueling operations shall be accomplished in accordance with accepted commercial procedures. Refer to paragraph 2-84 (c).

Table 2-6. Standard, Alternate, and Emergency Fuels

ENGINE	ARMY STANDARD FUEL	ALTERNATE FUEL	EMERGENCY FUEL	
			TYPE	*MAX. HOURS
T74-CP-700	MIL-T-5624 Grade JP-4	MIL-T-5624 Grade JP-5	MIL-G-5572 Any AV Gas	150

*Maximum operating hours with indicated fuel between engine overhauls (TBO).

g. Fuel Types. Approved fuel types are as follows:

(1) Army standard fuels. These are the Army-designated primary fuels adopted for worldwide use, and are the only fuels available in the Army supply system.

(2) Alternate fuels. These are fuels which can be used continuously when Army standard fuel is not available, without reduction of power output. Power setting adjustments and increased maintenance may be required when an alternate fuel is used.

(3) Emergency fuel. There are fuels which can be used if Army standard and alternate fuels are not available. There use is subject to a specific time limit.

h. Use of Fuels. Fuel is used as follows:

(1) Fuel limitations. There is no special limitation on the use of Army standard fuel, but certain limitations are imposed when Alternate or Emergency fuels are used. For the purpose of recording fuel mixtures shall be identified as to the major component of the mixture, except when the mixture contains leaded gasoline. A fuel mixture which contains over 10 percent leaded gasoline shall be recorded as all leaded gasoline. The use of any fuels other than standard will be entered in the FAULTS/REMARKS column of DA Form 2408-13, Aircraft Maintenance and Inspection Record, noting the type of fuel, additives, and duration of operation.

(2) Use of kerosene fuels. The use of kerosene fuels (JP-5 type) is turbine engines dictates the need for observance of special precautions. Both ground starts and air restarts at low temperature may be more difficult due to low vapor pressure.

(3) Mixing of fuels in aircraft tanks. When changing from one type of authorized fuel to another, for example JP-4 to JP-5, it is not necessary to drain the aircraft fuel system before adding the new fuel.

(4) Fuel specifications. Fuels having the same NATO code number are interchangeable. Jet fuels conforming to ASTM D-1655 specification may be used when MIL-T-5624 fuels are not available. This usually occurs during cross country flights where aircraft using NATO F-44 (JP-5) are refueled with NATO F-40 (JP-4) or Commercial ASTM Type B fuels. Whenever this condition occurs, the engine operating characteristics may change in that lower operating temperatures, slower acceleration, lower engine speed, easier starting, and shorter range may be experienced. The reverse is true when changing

from F-40 (JP-4) fuel to F-44 (JP-5) or Commercial AST. Type A-1 fuels. Most commercial turbine engines will operate satisfactorily on either kerosene of JP-4 type fuel. However, the difference in specific gravity may possible require fuel control adjustments; if so, the recommendations of the manufacturers of the engine and airframe are to be followed.

2-85. Servicing Oil System.

CAUTION

Do not mix MIL-L-23699 oil with MIL-L-7808 oil except in case of emergency. If it becomes necessary to mix the oils, the applicable system shall be flushed within six hours and filled with the proper oil.

CAUTION

Make sure oil filler cap latch tab is pointed aft.

An integral oil tank occupies the cavity formed between the accessory gearbox housing and the compressor inlet case on the T74-CP-700 engine. The tanks have a total oil capacity of 2.3 gallons and features a calibrated oil dipstick and an oil drain plug. If engine had been satisfactory for more than 12 hours, carry out a motoring run (no ignition) before checking oil level. Avoid spilling oil. Any oil spilled must be removed immediately. Use a cloth moistened in solvent to remove oil. Overfilling may cause a discharge of oil through the accessory gearbox breather until a satisfactory level is reached. Service oil system as follows:

1. Open the upper rear cowling to gain access to the oil filler cap and dipstick.
2. Remove oil filler cap.
3. Insert a clean funnel, with a 100 micron screen incorporated, into the filler neck.
4. Replenish with oil to within 1 quart below MAX mark on dipstick.
5. Check oil filler cap for damaged performed packing, general condition and locking.
6. Secure oil filler cap.
7. Check for and remedy any oil leaks.

2-86. Servicing Hydraulic Brake System Reservoir.

1. Gain access to brake hydraulic system reservoir (fig. 2-23).

NOTE

The hydraulic brake system reservoir for the aircraft is located on the right side of the bulkhead in the nose avionics compartment.

2. Remove brake reservoir cap and fill reservoir to washer on dipstick with hydraulic fluid.
3. Install brake reservoir cap.

2-87. Inflating Tires.

Inflate tires as follows:

1. Inflate nose wheel tire to a pressure between 50 to 55 PSI. (For very soft field takeoffs, nose wheel tire pressure should be between 30 and 32 PSI.)
2. Inflate main wheel tires to a pressure between 49 and 55 PSI for 12 ply tires.

2-88. Anti-icing, Deicing and Defrosting Protection.

The aircraft is protected in subfreezing weather by spraying the surfaces (to be covered with protective covers) with defrosting fluid. Spraying defrosting fluid on aircraft surfaces before installing protective covers will permit protective covers to be removed with a minimum of sticking. To prevent freezing rain and snow from blowing under protective covers and diluting the fluid, insure that protective covers are fitted tightly. As a deicing measure, keep exposed aircraft surface wet with fluid for protection against frost.

NOTE

Do not apply anti-icing, deicing and defrosting fluid on exposed aircraft surfaces if snow is expected. Melting snow will dilute the defrosting fluid and form a slush mixture which will freeze in place and become difficult to remove.

2-89. Anti-Icing, Deicing and Defrosting Treatment.

1. Use undiluted anti-icing, deicing and defrosting fluid (MIL-A-8243) to treat aircraft surfaces for protection against freezing rain and frost. Spray aircraft surface sufficiently to wet area, but without excessive drainage. A fine spray is recommended to prevent waste. Use diluted, hot fluid to remove ice accumulations.
2. Remove frost or ice accumulations from aircraft surfaces by spraying with diluted anti-icing, deicing, and defrosting fluid mixed in accordance with Table 2-7.
3. Spray diluted, hot fluid in a solid stream (not over 15 gallons per minute). Thoroughly saturate aircraft surface and remove loose ice. Keep a sufficient guantity of diluted, hot fluid on aircraft surface coated with ice to prevent liquid layer from freezing. Diluted, hot fluid should be sprayed at a high pressure, but not exceeding 300 PSI.
4. When facilities for heating are not available and it is deemed necessary to remove ice accumulations from aircraft surfaces, undiluted defrosting fluid may be used. Spray undiluted defrosting fluid at 15 minute intervals to assure complete coverage. Removal of ice accumulations using undiluted defrosting fluid is expensive and slow.
5. If tires are frozen to ground, use undiluted defrosting fluid to melt ice around tire. Move aircraft as soon as tires are free.

2-90. Application of External Power.

CAUTION

Before connecting the power cables from the external power source to the aircraft, insure that the GPU is not touching the aircraft at any point. Due to the voltage drop in the cables, the two ground systems will be of different potentials. Should they come in contact while the GPU is operating, arcing could occur. Turn off all external power while connecting the power cable to, or removing it from the external power supply receptacle. Be certain that the polarity of the external power source is the same as that of the aircraft before it is connected. The GPU shall not exceed 28 VDC.

An external power source is often needed to supply the electric current required to properly ground service the aircraft electrical equipment and to facilitate starting the aircraft engines. An external DC power receptacle is installed on the outboard side of the right engine nacelle. A GPU capable of delivering a continuous output of 1000 amperes is required.

2-91 Servicing Oxygen System.

The oxygen system furnishes breathing oxygen to the pilot, copilot and observer. Refer to Section VII for location of oxygen cylinders.

a. Oxygen System Safety Precautions.

WARNING

Keep fire and heat away from oxygen equipment. Do not smoke while working with or near oxygen equipment, and take care not to generate sparks with carelessly handled tools when working on the oxygen system.

1. Keep oxygen regulators, cylinders, gages, valves, fittings, masks, and all other components of the oxygen system free of oil, grease, gasoline, and all other readily combustible substances. The utmost care must be exercised in servicing, handling, and inspecting the oxygen system.
2. Do not allow foreign matter to enter oxygen lines.
3. Never allow electrical equipment to come in contact with the oxygen cylinder.
4. Never use oxygen from a cylinder without first reducing its pressure through a regulator.

b. Replenish Oxygen System.

1. Remove protective cap on oxygen cylinder filler valve.
2. Attach oxygen hose from oxygen servicing unit to filler valve.

Table 2-7. Recommended Fluid Dilution Chart

AMBIENT TEMPERATURE (°F)	PERCENT DEFROSTING FLUID BY VOLUME	PERCENT WATER BY VOLUME	FREEZING POINT OF MIXTURE (°F) (APPROXIMATE)
+ 30° and above	20	80	+ 10°
+ 20°	30	70	0°
+ 10°	40	60	-15°
0°	45	55	-25°
-10°	50	50	-35°
-20°	55	45	-45°
-30°	60	40	-55°

NOTES: 1. Use anti-icing and deicing fluid (MIL-A-8243).

2. Heat mixture to a temperature of 180° to 200°F (82° to 93°C).

WARNING

If the oxygen cylinder pressure is below 50 PSI, do not attempt to service system. Make an entry on DS Form 2408-13.

3. Insure that supply cylinder shutoff valves on the aircraft are open.
4. Fill system slowly to prevent overheating by adjusting recharging rate with pressure regulating valve on oxygen servicing unit.
5. Close pressure regulating valve on oxygen servicing unit when pressure gage on oxygen cylinder indicates the pressure obtained from the oxygen system servicing chart (fig. 2-24).
6. Disconnect oxygen hose from oxygen servicing unit and filler valve.
7. Install protective cap on oxygen filler valve.

2-92. Ground Handling.

Ground handling covers all the essential information concerning movement and handling of the aircraft while on the ground. The following paragraphs give, in detail, the instructions and precautions necessary to accomplish ground handling functions.

a. General Ground Handling Procedure. Accidents resulting in injury to personnel and damage to equipment can be avoided or minimized by close observance of existing safety standards and recognized ground handling procedures. Carelessness or insufficient knowledge of the aircraft or equipment being handled can be fatal. The applicable technical manuals and pertinent directives should be studied for familarization with the aircraft, its components, and the ground handling procedures applicable to its, before attempting to accomplish ground handling.

b. Ground Handling Safety Practice. Aircraft equipped with turboprop engines require additional maintenance safety practices. The following list of safety practices should be observed at all times to prevent possible injury to personnel and/or damaged or destroyed aircraft:

1. Keep intake air ducts free of loose articles such as rags, tools, etc.
2. Stay clear of exhaust outlet areas (fig. 8-2).

3. During ground runup, make sure the brakes are firmly set.
4. Keep area fore and aft of propellers clear of maintenance equipment.
5. Do not operate engines with control surfaces in the LOCKED position.
6. Do not attempt towing or taxiing of the aircraft with control surfaces in the LOCKED position.
7. When high winds are present, do not unlock the control surfaces until prepared to properly operate them.
8. Do not operate engines while towing equipment is attached to the aircraft, or while the aircraft is tied down.
9. Check the nose wheel position. Unless it is in the centered position, avoid operating the engines at high power settings.
10. Hold control surfaces in the neutral position when the engines are being operated at high power settings.
11. Keep personnel clear of exhaust danger area.
12. When moving the aircraft, do not push on propeller deicing boots. Damage to the heating elements may result.

c. Moving Aircraft on Ground. Aircraft on the ground shall be moved in accordance with the following:

(1) Taxiing. Taxiing shall be in accordance with chapter 8.

CAUTION

When the aircraft is being towed, a qualified person must be in the pilot's seat to maintain control by use of the brakes. When towing, do not exceed nose gear turn limits. Avoid short radius turns, and always keep the inside of pivot wheel turning during the operation. Do not tow aircraft with rudder locks installed, as severe damage to the nose steering linkage can result. When moving aircraft backwards, do not apply the brakes abruptly. Tow the aircraft slowly, avoiding sudden stops, especially over snowy, icy, rough, soggy, or muddy terrain. In arctic climates, the aircraft must be towed by the main gears, as an immense breakaway load, resulting from ice, frozen tires, and stiffened grease in the wheel bearings may damage the nose gear.

CAUTION

Do not tow or taxi aircraft with deflated shock struts.

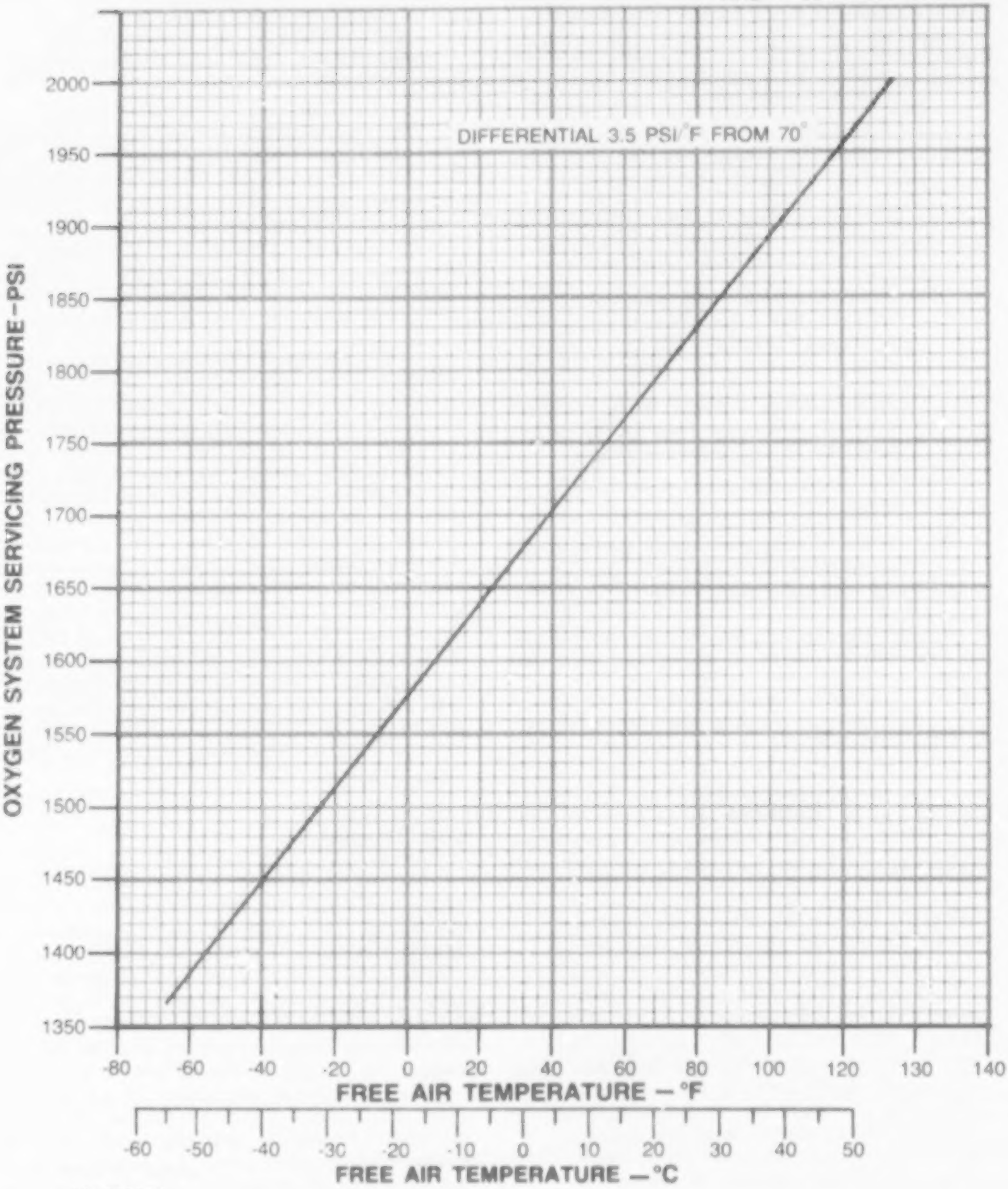
(2) Towing. Towing lugs are provided on the upper torque knee fitting of the nose strut. When it is necessary to tow the aircraft with a vehicle, use the vehicle tow bar (fig. 2-25). In the event towing lines are necessary, use towing lugs on the main landing gears. Use towing lines long enough to clear nose and/or tail by at least 15 feet. This length is required to prevent the aircraft from overrunning the towing vehicle or fouling the nose gear.

d. Ground Handling Under Extreme Weather Conditions. Extreme weather conditions necessitate particular care in ground handling of the aircraft. In hot, dry, sandy, desert conditions, special attention must be devoted to finding a firmly packed parking and towing area. If such areas are not available, steel mats or an equivalent solid base must be provided for these purposes. In wet, swampy areas, care must be taken to avoid bogging down the aircraft. Under cold, icy, arctic conditions, additional mooring is required, and added precautions must be taken to avoid skidding during towing operations. The particular problems to be encountered under adverse weather conditions and the special methods designed to avoid damage to the aircraft are covered by the various phases of the ground handling procedures included in this section of general ground handling instructions. (Refer to TM 55-1500-204-25/1.)

2-93. Parking.

Parking is defined as the normal condition under which the Aircraft will be secured while on the ground. This condition may vary from the temporary expedient of setting the parking brake and chocking the wheels to the more elaborate mooring procedures described in paragraph 2-94. The proper steps for securing the aircraft must be based on the time the aircraft will be left unattended, the aircraft weight, the expected wind direction and velocity, and the anticipated availability of ground and air crews for mooring and/or evacuation. When practical head the aircraft into the wind, especially if strong winds are forecast of if it will be necessary to leave the aircraft overnight. Set the parking brake and chock the wheels securely. Following engine shutdown, position and engage the control locks.

OXYGEN SYSTEM SERVICING PRESSURE



NOTE - LIMITATIONS FOR THIS CHART ARE – 65°F AND +175°F

AP 006219

Figure 2-24. Oxygen System Servicing Pressure

NOTE

Cowlings and loose equipment will be suitably secured at all times when left in an unattended condition.

a. The parking brake system for the aircraft incorporates two lever-type valves, one for each wheel brake. Both valves are closed simultaneously by pulling out the parking brake handle. Operate the parking brake as follows:

1. Depress both pilot's toe brakes
2. Pull parking brake handle out. This will cause the parking brake valves to lock the hydraulic fluid under pressure in the parking brake system, thereby retaining braking action.

NOTE

Parking brake cannot be set by using copilot's brake pedals

3. Release pilot's toe brake pedals.

CAUTION

Do not set parking brakes when the brakes are hot during freezing ambient temperatures. Allow brakes to cool before setting parking brakes.

4. To release the parking brakes push in on the parking brake handle.

b. The control lock (fig. 2-16) holds the engine and propeller control levers in a secure position, and the elevator, rudder, and aileron in neutral position. Install the control locks as follows:

1. With engine and propeller control levers in secure position, slide lock onto control pedestal to prevent operation of levers.
2. Install elevator and aileron lockpin vertically through pilot's control column to lock control wheel.
3. Install rudder lock pin through right hand pilot's rudder pedal; then neutralize and lock pedals together.
4. Reverse steps 1 through 3 above to remove control lock. Store control lock.

2-94. Installation of Protective Covers.

While in transit, the crew will insure that the aircraft is protected during inclement weather. If protective covers (fig. 2-25) are not on board, steps will be taken to procure them from the airfield maintenance facility.

2-95. Mooring.

The aircraft is moored to insure its immovability, protection, and security under various weather conditions. The following paragraphs give, in detail, the instructions for proper mooring of the aircraft.

a. Mooring Provisions. Mooring points (fig. 2-26) are provided beneath the wing, nose, tail and on each main landing gear. General mooring equipment and procedures necessary to moor the aircraft, in addition to the following, are given in TM 55-1500-204-25/1.

(1) Use mooring cables of 1/4 inch aircraft cable and clamp (clip-wire rope), chain or rope 3/8 inch or over. Length of the cable or rope will be dependent upon existing circumstances. Allow sufficient slack in ropes, chains, or cable to compensate for tightening action due to moisture absorption of rope or thermal contraction of cable or chain.

CAUTION

Do not use slip knots. Use bowline knots to secure aircraft to mooring stakes.

(2) One-piece wheel chocks or wood blocks may be used to chock the main landing gear wheels. They must be equipped with rope or wood cleats to retain them against the wheels.

NOTE

In ice or snow conditions, collapsible ice grip wheel chocks should be used. However, sandbags may be used if collapsible chocks are not available or if parking or mooring the aircraft on steel mats.

b. Mooring Procedures for High Winds. If an aircraft is to remain securely moored during high velocity winds, it is necessary to use the proper size and type of wheel chock. Since the factor of weight is significant in determining adequate mooring provisions, the approximate weight must be known if the aircraft is to be properly secured. During emergencies, knowledge of this information is very useful in selecting the aircraft that should be tied down

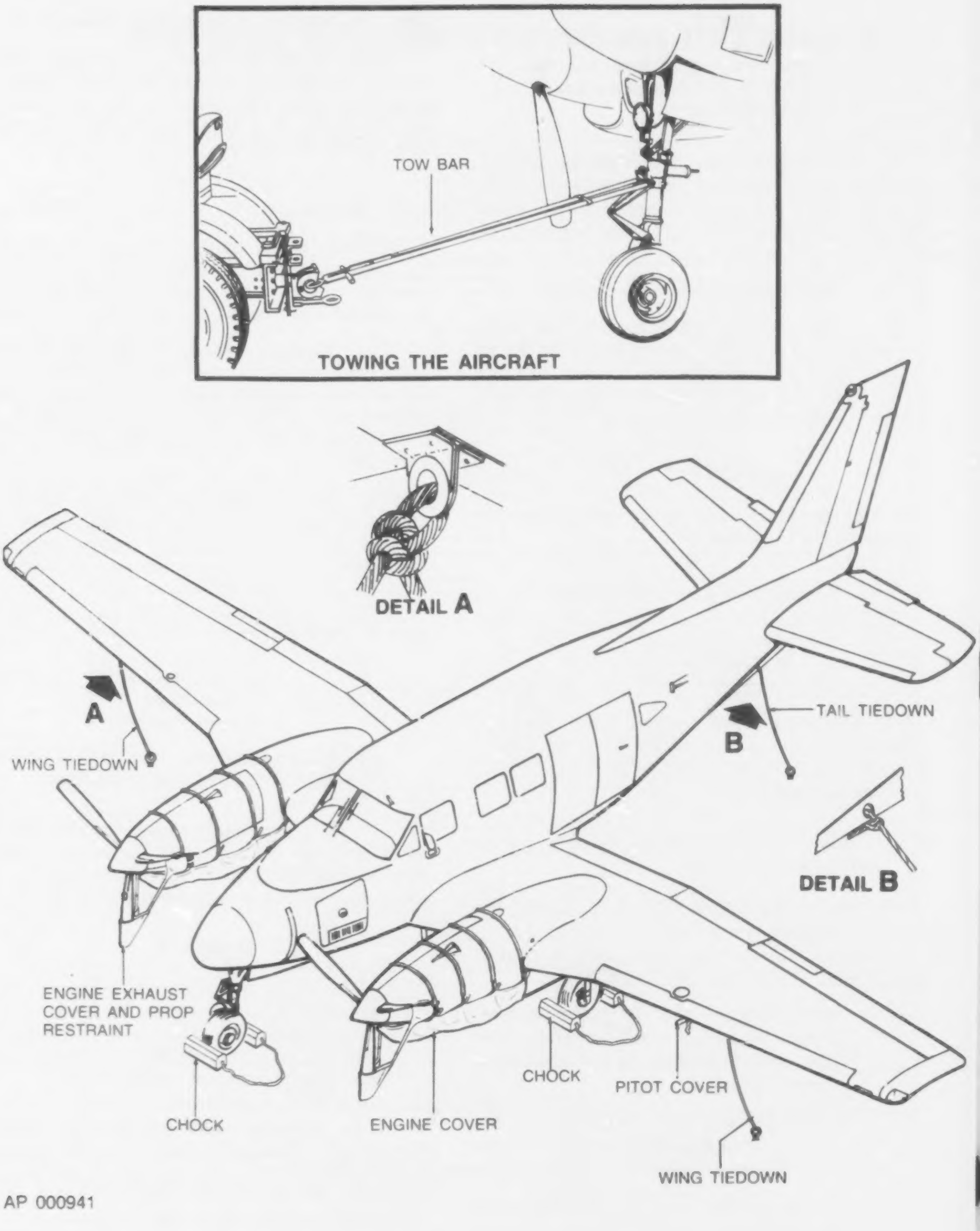

TOW BAR
TOWING THE AIRCRAFT
DETAIL A
A
WING TIEDOWN
B
TAIL TIEDOWN
DETAIL B
ENGINE EXHAUST COVER AND PROP RESTRAINT
CHOCK
ENGINE COVER
CHOCK
PITOT COVER
WING TIEDOWN
AP 000941

Figure 2-25. Parking, Covers, Ground Handling and Towing Equipment

first, as a heavy aircraft will better stand high winds than an empty aircraft.

CAUTION

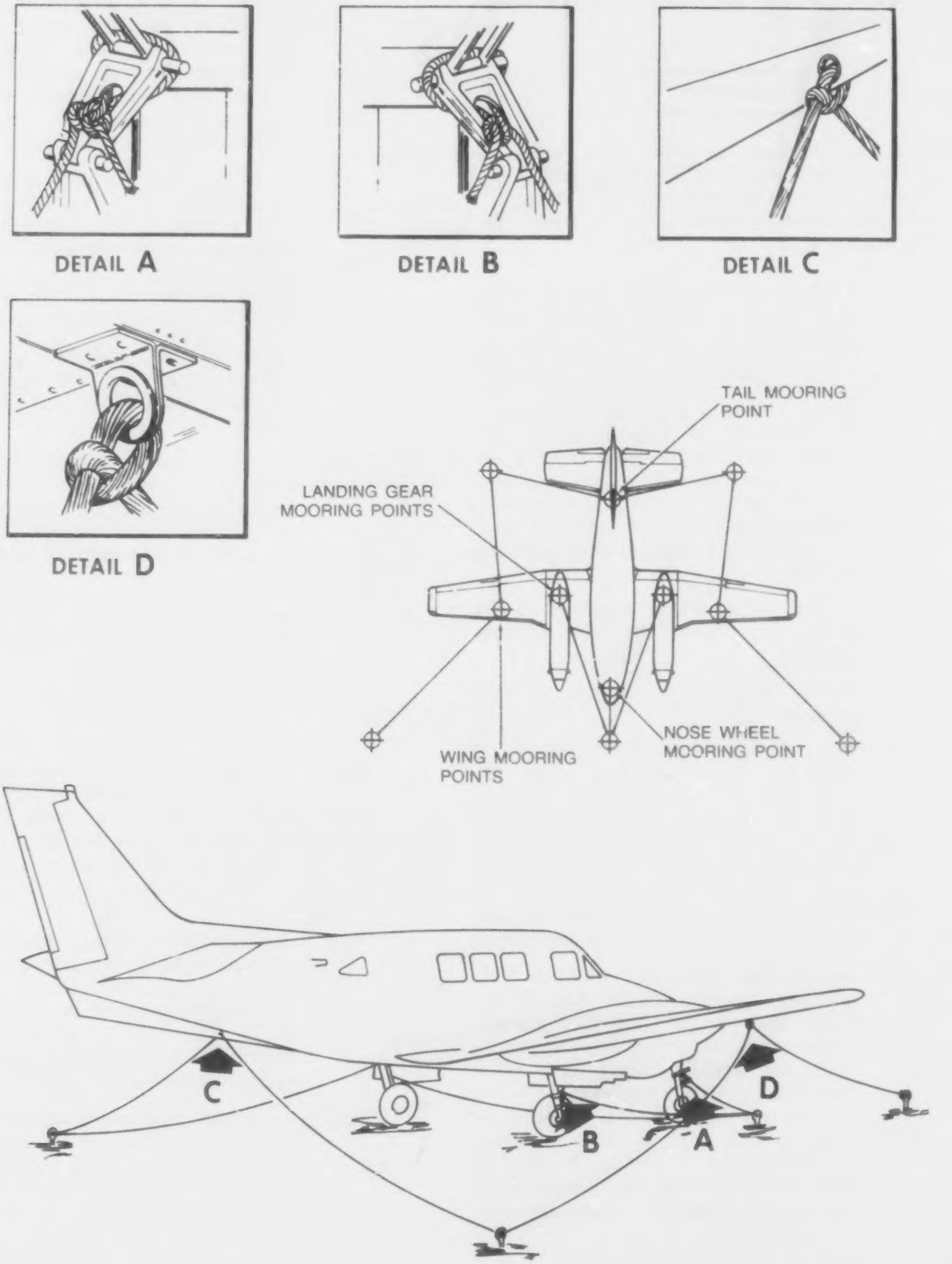
Structural damage can occur from high velocity winds; therefore, if at all possible, the aircraft should be moved to a safe weather area when winds above 75 knots are expected.

1. After aircraft is properly located, place nose wheel in centered position. Head aircraft into the wind, or as nearly so as is possible within limits determined by locations of fixed mooring rings. When necessary a 45 degree variation of direction is considered to be satisfactory. Locate each aircraft at slightly more than wing span distance from all other aircraft. Position nose mooring point approximately 3 to 5 feet downwind from ground mooring anchors.
2. Deflate nose wheel shock strut to within 3/4 inch of its fully deflated position.
3. Fill all fuel tanks to capacity, if time permits.
4. Place wheel chocks fore and aft of main gear wheels and nose wheel. Tie each pair of chocks (wood) together with rope or join together with wooden cleats nailed to chocks on either side of wheels. Tie ice grip chocks together with rope. Use sandbags in lieu of chocks when aircraft is moored on steel mats. Set parking brake as applicable.
5. Accomplish aircraft tiedown by utilizing mooring points (fig. 2-26). Make tiedown with 1/4 inch aircraft cable, using two wire rope clips, or bolts, and a chain tested for a 3000 pound pull. Attach tiedowns so as to remove all slack. (Use a 3/4-inch or larger manila rope if cable or chain tiedown is not available). If rope is used for tiedown, use anti-slip knots. In the event tiedown rings are not available on hard surfaces areas, move aircraft to an area where portable tiedowns can be used. When anchor kits are not available, use metal stakes or dead-man type anchors, providing they can successfully sustain a minimum pull of 3000 pounds.
6. In event nose position tiedown is considered to be of doubtful security due to existing soil condition, drive additional anchor rods at nose tiedown position. Place padded work stand or other suitable support under the aft fuselage tiedown position and secure.
7. Place control surfaces in locked position and trim tab controls in neutral position. Place wing flaps in up position.
8. The requirements for dust excluders, protective covers, and taping of openings will be left to the discretion of the responsible maintenance officer or the pilot of the transient aircraft (fig. 2-25).
9. Secure propellers to prevent windmilling (fig. 2-25).
10. Disconnect battery.

NOTE

Where typhoon or hurricane conditions exist, it is well to remember that the storm appears to pass two times, each time with a different wind direction. This will necessitate turning the aircraft after the first passing.

11. During typhoon or hurricane wind conditions, mooring security can be further increased by placing sandbags along the wings to break up the aerodynamic flow of air over the wing, thereby reducing the lift being applied against the mooring by the wind.
12. After high winds, inspect aircraft for visible signs of structural damage and for evidence of damage from flying objects. Service nose shock strut and reconnect battery.


DETAIL A
DETAIL B
DETAIL C
DETAIL D
TAIL MOORING POINT
LANDING GEAR MOORING POINTS
WING MOORING POINTS
NOSE WHEEL MOORING POINT
C
D
B
A

AV 094068

Figure 2-26. Mooring the Aircraft

CHAPTER 3

AVIONICS

SECTION I. GENERAL

3-1. Introduction.

This chapter covers avionics equipment configuration installed in the aircraft. It includes a brief description of the avionics equipment, its technical characteristics, capabilities, and location.

3-2. Avionics Equipment Configuration.

The avionics configuration of the aircraft is comprised of three groups of electronic equipment. The communication equipment group consists of the radio telephone (if installed), interphone, FM liaison (if installed), UHF command, VHF command, and HF command (if installed) systems. The navigation equipment group provides the pilot and copilot with the instrumentation required to establish and maintain an accurate flight course and position, and to make an approach on instruments under instrument meteorological conditions (IMC). The navigation group includes equipment for determining altitude, attitude, position, destination, and drift angle. The transponder and radar group includes an identification, position, and emergency tracking system, and a radar system to locate potentially dangerous weather areas.

3-3. Power Source.

a. DC Power. DC power for the avionics equipment is provided by four sources; the aircraft battery, left and right generators, and external power. Power is routed through a 50-ampere circuit breaker to the avionics power relay which is controlled by the AVIONICS MASTER power switch (fig. 2-22) on the pilot's side of the instrument panel. Individual system circuit breakers and associated avionics busses are shown in figure 2-18 and figure 2-19. With the AVIONICS MASTER power switch in the ON position, the avionics power relay is de-energized and power is applied through two 50-ampere AVIONICS NO. 1 and 2 circuit breakers to the individual avionics circuit breakers on the circuit breaker panel (fig. 2-18). In the OFF position, the relay is energized and power is removed from avionics equipment. When external power is applied to the aircraft, the avionics power relay is normally energized, removing power to the avionics equipment.

NOTE

The avionics master switch and radar should not normally be turned on, until the generators are on. This will help protect the solid-state circuitry.

b. AC Power. AC power for the avionics equipment is provided by two separately selected inverters. The inverters supply 115-volt and 26 volt single-phase AC power. The inverters are selected by a switch located on the left subpanel, placarded INVERTER LEFT OFF RIGHT. Either inverter may be selected for use.

SECTION II. COMMUNICATIONS

3-4. Description.

The communication equipment group consists of radio telephone (if installed), interphone, FM liaison (if installed), UHF command, VHF command, and HF command (if installed) systems.

3-5. Microphone Switches.

a. Description. Three microphone switches are provided for the pilot and copilot: A bi-level microphone switch placarded INPH XMT MIC, located on the pilot's and copilot's control wheels; a floor switch placarded MIC, located on the floor in front of the pilot's and copilot's seats; and a push-button switch located in each headset microphone jack (pigtail).

b. Controls and Functions.

(1). INPH-XMT MIC switch. Keys interphone or selected facility.

(a.) INPH. When depressed to first detent, keys interphone regardless of audio panel selector switch position.

(b.) XMIT MIC. When depressed fully, keys facility indicated on audio panel selector switch.

3-6. Interphone System.

a. Description. Identical audio control panels are provided for the pilot and copilot. The controls and switches on each panel provide for audio reception of interphone, communication, navigation audio signals, and a choice of transmission on VHF, UHF, and HF (if installed). Cabin speakers and crew headphones are utilized for audio reception. Aircraft power for speaker and headphone isolation amplifiers is derived from separate sources to provide a high degree of audio integrity. The power is routed through 3-ampere circuit breakers placarded SPKR 1 and SPKR 2, and 1-ampere circuit breakers placarded PHONE 1 and PHONE 2, located on the lower right sub panel.

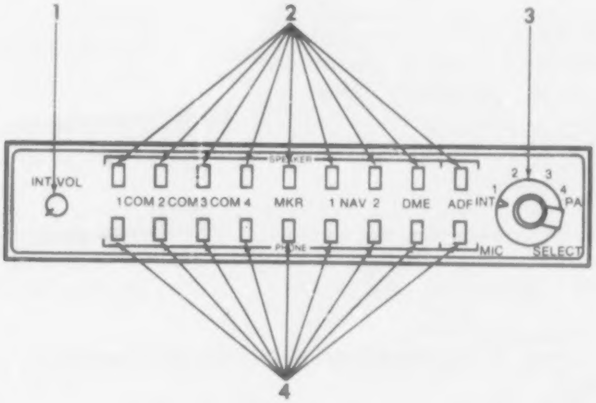
b. Audio Panel (KMA 24H). The controls and switches on the KMA 24H audio control panel (fig. 3-1) provide for selection and volume control of interphone, communication, and navigation audio signals.

c. Controls and Functions.

(1) INT VOL control. Volume of the intercom input is controlled by the INT VOL control. This control affects intercom volume only. It does not affect volume of other audio inputs selected with the pushbuttons.

(2) Speaker audio select buttons. Selects desired audio inputs to be heard on the speakers.

(3) MIC SELECT switch. The MIC SELECT switch performs several functions. It routes microphone audio and keying to the appropriate system and switches the speaker amplifier output to the appropriate speaker. In the 1, 2, 3, or 4 positions, microphone audio and keying are routed to the appropriate transceiver and the speaker amplifier output is connected to the cockpit speakers. In the PA position, microphone audio is routed to the speaker amplifier. The speaker amplifier output is connected to the passenger address speakers. In the INT position, microphone audio is routed to the intercom output. In INT, 1, 2, 3, or 4 positions, any audio output selected on the top row of pushbuttons will be heard through the cabin speakers. Keying causes the output audio to be muted and the sidetone audio to be heard.



1. INT VOL switch
2. SPEAKER audio select buttons
3. MIC SELECT switch
4. PHONE audio select buttons

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Figure 3-1. Audio Control Panel

(a.) INT. Permits the flight crew to communicate with cabin occupants through headphones.

(b.) #1. Selects COMM 1 position.

(c.) #2. Selects COMM 2 position.

(d.) #3. Selects UHF position.

(e.) #4. Selects HF radio position (if installed).

(f.) PA. Permits the flight crew to address aft cabin occupants over the passenger address speakers.

(4) Headphone audio select buttons. Selects audio input to heard on the headphones.

d. Operating Procedures.

1. AVIONICS MASTER Switch - ON.
2. MIC SELECT Switch - As required.
3. Audio Select Button - As required.
4. INT VOL - Adjust as required if INT is selected.

3-7. FM Liaison Set (AN/ARC-131) (If installed).

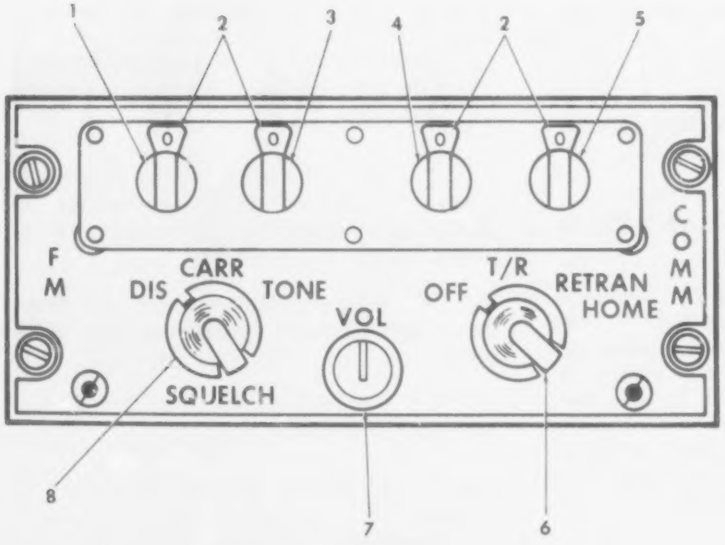
The FM liaison set (fig. 3-2) is a radio transceiver which provides two-way frequency modulated (FM) communications in the 30.00 to 75.95 MHz range for a distance of approximately 50 miles. The FM liaison set is used for voice communications and FM homing. The audio output is applied to the respective audio control panel where it is made available to the headsets. Power for the FM liaison set is fed through 50-ampere AVIONICS NO.1 and AVIONICS NO.2 circuit breakers, located on the copilot's circuit breaker panel. The unit is protected by a 10-ampere circuit breaker, placarded FM, located on the copilot's subpanel.

a. Controls and Functions.

(1) Megahertz selector. Tunes transceiver in 10-MHz, as indicated by the first digit of the frequency indicator.

(2) Frequency indicator. Indicates frequency to which transceiver is tuned.

(3) Megahertz selector. Tunes transceiver in 1-MHz, as indicated by the second digit of the frequency indicator.



1. Megahertz (10) selector
2. Frequency indicator
3. Megahertz (1) selector
4. Kilohertz (100) selector
5. Kilohertz (10) selector
6. Mode selector
7. VOL control
8. SQUELCH switch

AV 094957

Figure 3-2. FM Liaison Set (AN/ARC-131)

(4) Kilohertz selector. Tunes transceiver in 100-kHz, as indicated by the third frequency indicator.

(5) Kilohertz selector. Tunes transceiver in 50-kHz, as indicated by the fourth frequency indicator.

(6) Mode selector. Determines operating mode.

(a.) OFF. Turns set off.

(b.) T/R. Provides for transceiver operation of frequency displayed on frequency indicator.

(c.) RETRAN. Not used in this installation.

(d.) HOME. Provides for operation in the homing mode. May also be operated as a transceiver on channels indicated on frequency indicator.

(7) VOL control. Adjusts volume.

(8) SQUELCH switch. Controls squelch.

(a.) DIS. Disables receiver squelch circuit.

(b.) CARR. Activates receiver squelch circuits.

(c.) TONE. Not used in this installation.

b. Operating Procedures.

1. Refer to Voice Security System operating procedures.

3-8. Voice Security System (TSEC/KY-28) (If installed).

a. Description. The voice security system is used in conjunction with the FM liaison set to provide secure (ciphered), two-way voice communications (fig. 3-3). Power for the voice security system is fed through the 50-ampere AVIONICS NO.1 and AVIONICS NO.2 circuit breakers on the copilot's circuit breaker panel. The voice security system is protected by a 10-ampere circuit breaker, placarded FM, located on the copilot's subpanel.

b. Controls and Functions.

(1) POWER ON switch. Turns set on or off.

NOTE

Switch must be in the ON position for FM liaison operations in either the plain or cipher mode.

(2) POWER ON indicator. Illuminates when the POWER ON switch is placed in the up (on) position.

(3) PLAIN indicator. Illuminates when the PLAIN/CIPHER switch is in the PLAIN position.

(4) PLAIN/CIPHER switch. Controls unciphered or ciphered communications.

(a.) PLAIN. Permits unciphered communications on the FM liaison set.

(b.) CIPHER. Permits ciphered communications on the FM liaison set.

(5) RE-X/REG switch. Controls retransmission, or cipher/normal communications.

(a.) RE-X. Permits retransmission of ciphered communications at a distant location.

(b.) REG. Permits normal cipher or plain communications.

NOTE

Do not place the Zeroize switch in the ON position unless a crash or capture is imminent.

(6) ZEROIZE switch. Normally in OFF position. Placed in ON position during emergency situations to neutralize and make inoperative the associated cipher equipment.

(7) CIPHER indicator. Illuminates when the PLAIN/CIPHER switch is in the CIPHER position.

c. Operating Procedures for FM Liaison Set and Voice Security System.

NOTE

Disregard the operating procedures involving the voice security (CIPHONY) control-indicator if this unit is not installed.

NOTE

The audio discriminators will automatically interrupt the FM receiver audio at a given position whenever the UHF, VHF, or HF transmitter is keyed from that position.

(1) Turn-on Procedure. POWER ON switch (CIPHONY control-indicator) - ON.

NOTE

The POWER ON switch must be in the ON position regardless of the mode of operation, whenever the voice security (CIPHONY) KY-28 is installed in the aircraft.

(2) Receiver Operating Procedure.

1. SQUELCH switch (FM COMM control panel) - As required.
2. Mode selector (FM COMM control panel) - T/R or PTT.
3. Frequency selectors (FM COMM control panel) - As required.

(3) Transmitter Operating Procedure (PLAIN).

1. Transmitter-indicator selector (audio control panel) - No.1 position.
2. PLAIN/CIPHER switch (CIPHONY control-indicator) - PLAIN.
3. Microphone switch - Press.

(4) Transmitter Operating Procedure (CIPHER).

1. Transmitter-interphone selector (audio control panel) - No.1 position.
2. PLAIN/CIPHER switch (CIPHONY control-indicator) - CIPHER.
3. RE-X REG switch (CIPHONY control-indicator) - As required (RE-X position only if distant station is using retransmitting equipment).
4. Microphone switch - Press momentarily (interrupted tone from voice security unit should no longer be heard).

NOTE

No traffic will be passed if the interrupted tone is still heard from pressing and releasing the microphone switch.

5. Microphone switch - Press (do not talk). Wait until beep is heard, then speak into microphone.

(5) Homing Operating Procedure.

NOTE

Accuracy of the FM liaison set has been verified on the following frequencies only: 32.00, 34.50, 38.90, and 39.50 MHz.

1. Mode selector (FM COMM control panel) - HOME.
2. Frequency selectors (FM COMM control panel) - Select.
3. VOL control (FM COMM control panel) - As required.
4. Pilot or copilot's COURSE IND switch (instrument panel) - HOME.

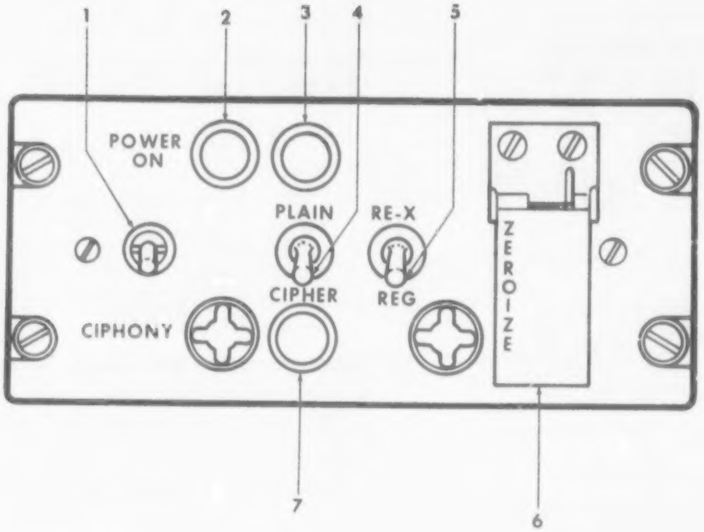
NOTE

FM homing steering signals can be displayed only on one course indicator-selector) at a time.

5. Course deviation indicator (pilot or copilot's course indicator-selector) - Read lateral deviation from homing course.
6. Glideslope indicator (pilot or copilot's course indicator-selector) - Read relative signal strength. Indicator will deflect towards the bottom for a weak signal and move toward the center position as the signal strength increases.

(6) Shutdown Procedure.

1. Mode selector (FM COMM control panel) - OFF.
2. POWER ON switch (CIPHONY control-indicator) - OFF.



1. POWER ON switch
2. POWER ON indicator
3. PLAIN indicator
4. PLAIN/CIPHER switch
5. RE-X/REG switch
6. ZEROIZE switch
7. CIPHER indicator

Figure 3-3. Voice Security Control-Indicator

3-9. UHF Command Set (AN/ARC-51BX) (If installed).

a. Description. The UHF command set (fig. 3-4) provides two-way amplitude modulated (AM) voice communication within the frequency range of 225./0 to 399.95 MHz for a distance range of approximately 50 miles line-of-sight. Channel selection is spaced at 50 kHz intervals. Additionally, a separate receiver is incorporated to provide monitoring capability for the UHF guard frequency (243.0 MHz). The audio output of the UHF set is applied to the audio control panel where it is made available to the headsets. Power for the UHF command set is fed through the 50-ampere AVIONICS NO.1 and AVIONICS NO.2 circuit breakers on the copilot's circuit breaker panel. The set is protected by a 15-ampere circuit breaker, placarded UHF, located on the copilot's subpanel.

b. Controls and Functions.

(1) Preset channel indicator. Indicates the preset channel in use when the mode selector is in the PRESET CHAN position.

(2) SQ DISABLE switch. Turns squelch circuit on or off.

(3) VOL control. Adjusts volume.

(4) Function switch. Selects type of operation and turns set off.

(5) Manual frequency selector. Selects the operating frequency when the mode selector is in the MAN position.

(6) Frequency. Indicates the operating frequency of the UHF receiver and transmitter when the mode selector is in the MAN position.

(7) Mode selector. Determines operation mode.

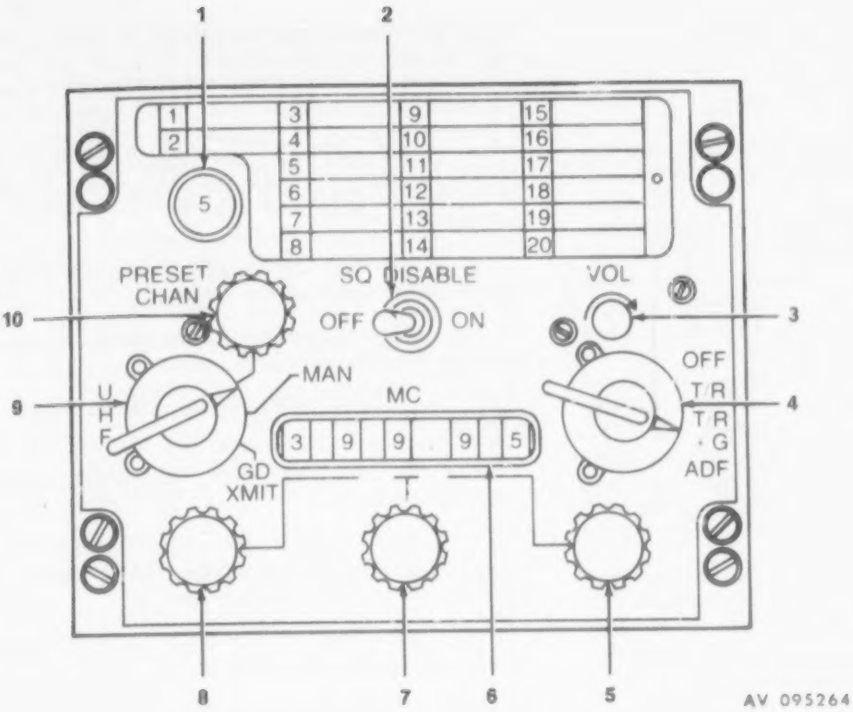
(a.) PRESET CHAN. Permits selection of one of 20 preset channels.

(b.) MAN. Permits frequency selection by means of manual frequency selector controls.

(c.) GD XMIT. Automatically tunes to the guard channel frequency.

(8) PRESET CHAN selector. Selects the desired preset channel when the mode selector is in the PRESET CHAN position.

c. UHF Command Set Operation. The function switch must be ON prior to performing the following procedures.



1. Preset channel indicator
2. SQ DISABLE switch
3. VOL control
4. Function switch
5. Decimal MC selector
6. MC indicator
7. One MC selector
8. Ten MC selector
9. Tuning mode switch
10. PRESET CHAN selector

Figure 3-4. UHF Command Set (AN/ARC-51BX)

(1) Receive Operating Procedure.

1. Mode selector - As required.
2. Frequency - Select required frequency using either preset channel control or manual frequency selectors.

NOTE

The preset CHAN selector and MANUAL frequency selectors are inoperative when the mode selector is set to GD XMIT position.

3. Volume - Adjust.

NOTE

To adjust volume when audio is not being received, turn squelch disable switch ON, adjust volume for comfortable noise level, then turn squelch disable switch OFF.

4. Squelch - As required.

(2) Transmit Operating Procedures.

1. Transmitter-interphone selector (audio control panel) - No.2 position.
2. Microphone switch - Press.

(3) Shutdown Procedure. Function switch - OFF.

d. UHF Command Set Emergency Operation.

NOTE

Transmission on emergency frequency (guard channel) shall be restricted to emergencies only. An emergency frequency of 121.500 MHz is also available on the VHF (KY-196) COMM-1 and/or COMM-2 radio sets.

1. Transmitter-interphone selector (audio control panel) - No.2 position.
2. PLAIN/CIPHER switch (CIPHONY control-indicator) - PLAIN.
3. Mode selector (UHF control panel) - GD XMIT.

4. Microphone switch - Press.

3-10. VHF Command Sets (KY 196).

a. Description. Identical VHF command sets are provided for the pilot and copilot, COMM 1 and COMM 2 respectively (fig. 3-5). The KY 196 transceiver is a communications transceiver designed to provide two-way voice communication within the frequency range of 118.000 MHz to 135.975 MHz, in 25 kHz increments. Active and standby frequencies may be transferred at anytime, by pressing a frequency transfer button. The frequency is tuned by the selector on the right side of the unit. It may be tuned in ascending or descending order, by rotating the selector clockwise or counterclockwise. The outer larger selector knob is used to change the MHz portion of the frequency while the smaller knob changes the kHz portion. The 5 kHz units will not be indicated in the readout display.

The OFF-PULL TEST control knob turns power off to the unit by rotating counterclockwise to the detent position and will increase volume by turning clockwise. This knob also overrides the automatic squelch by pulling it out for audio test.

The radios are protected by two 7 1/2-ampere circuit breakers placarded COMM VHF 1 VHF 2, located on the copilot's subpanel (fig. 2-7).

b. Controls and Functions.

(1) Active frequency display. Displays the frequency being used.

(2) Transmit symbol. A letter T will appear between the USE and STANDBY windows when the transceiver is in the transmit mode of operation.

(3) Standby frequency display. Displays the frequency selected for standby.

(4) Frequency selector knobs. Selects frequencies in MHz and kHz.

(a.) MHz knob. Selects MHz frequencies.

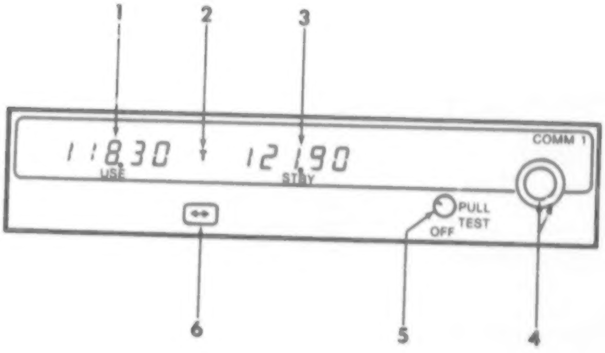
(b.) kHz knob. Selects kHz frequencies.

(5) OFF-PULL TEST switch. When turned clockwise, turns set on. When pulled out, provides for manual squelch control.

(6) Frequency transfer button. Transfers active and standby frequencies.

c. Mode of Operation.

(1) Frequency mode. In the frequency mode of operation frequencies are entered into the



1. Active frequency display
2. Transmit symbol
3. Standby frequency display
4. Frequency selector knobs
5. OFF-PULL TEST switch
6. Frequency transfer button

Figure 3-5. VHF Control Panel

STBY window of the display and may then be transferred into the USE window by pressing the frequency transfer button. To select frequencies, the MHz portion of the frequency displayed in the STBY window is incremented or decremented in 1 MHz steps by rotating the MHz knob either clockwise or counterclockwise. MHz frequencies will roll over or roll under at each band edge (118 or 135 MHz). The kHz portion of the frequency displayed in the STBY window may be incremented or decremented by rotating the 25 kHz knob either clockwise or counterclockwise. Frequency selection is in 50 kHz steps when the 25 kHz knob is pushed in and is in 25 kHz steps when the 25 kHz knob is pulled out. Frequencies roll over from 95 or 97 to 00 and roll under from 00 to 95 or 97 according to the position of the 25 kHz knob. Frequencies are transferred from STBY to USE window and vice versa by depressing the frequency transfer button.

d. Operating Procedures.

1. AVIONICS MASTER Switch - ON
2. OFF-PULL TEST Switch - Turn clockwise out of detent. The frequencies displayed will be those last used.
3. Audio Select Button (Audio Control Panel) - Select as required.
4. OFF-PULL TEST Switch - Pull out and rotate until the desired audio level is obtained. Push the knob back in to activate the automatic squelch.
5. Active Frequency - Insure desired active frequency is displayed in USE window.
6. Microphone Switch - Press to second detent.

e. Shutdown Procedure. Turn OFF-PULL TEST switch counterclockwise to the OFF position.

3-11. HF Communication Set (KHF 950).

a. Description. The KHF 950 HF system consists of three units; the pedestal mounted KCU 951 control display, the remote KAC 952 power amplifier/antenna coupler and KTR 953 receiver/exciter. The system operates on any 0.1 kHz frequency between 2,000 and 29,999.9 kHz. With the capability to preset and store 99 frequencies for selection during flight, the system also allows for selection of other frequencies manually (direct tuning), or reprogramming of any preset frequency. The system automatically matches the antenna by keying the microphone. Power to the system is routed through a 25 ampere circuit breaker, placarded HF, located on the copilot's circuit breaker panel.

b. Controls and Functions.

(1) FREQ display. Displays frequency selected.

(2) Mode display. Displays LSB, AM, or USB mode of operation as selected.

(3) CHANNEL display. Displays from 1 to 99 channels as selected.

(4) Light sensor. The light sensor is a photocell which automatically adjusts brightness of the display.

(5) MODE switch. The mode switch is a momentary pushbutton switch that selects LSB, AM or USB modes of operation.

(6) FREQ/CHAN switch. Transfers the HF system from a direct frequency operation to a channelized form of operation.

(7) PGM (program) recessed switch. Enables channelized data to be modified. The PGM message will be displayed whenever this switch is depressed.

(a.) Program. The program mode must be used for setting or changing any of the 99 preset frequencies. Each of the 99 channels may be preset to receive and transmit on separate frequencies (semi-duplex), receive only, or transmit and receive on the same frequency (simplex). The operating mode (LSB,USB or AM) must be the same for both receive and transmit and can also be preset.

(8) Frequency/channel selector. This selector consists of two concentric knobs that control the channel and frequency digits, plus the lateral position of the cursor.

(a.) Frequency control. The outer knob becomes a cursor (flashing digit) control with the FREQ/CHAN switch in the FREQ position. The flashing digit is then increased/decreased with the inner knob.

(b.) Channel control. The outer knob is not functional when the FREQ/CHAN switch is in the CHAN position. The inner knob will provide channel control from 1 through 99, displayed at the right end of the display window.

(9) STO (store) recessed switch. Stores displayed data when programming preset channels.

(10) OFF-VOLUME. Applies power to the unit and controls the audio output level.

(11) SQUELCH. Provides variable squelch threshold control. Squelch is set by rotating the knob clockwise until background noise is heard

then counterclockwise until the noise is just barely audible or absent. Squelch operation on HF is not as predictable as is VHF. Readjustment may be required more frequently.

(12) CLARIFIER. Provides 250 Hz of local oscillator adjustment, thus providing better SSB reception when a ground station is slightly off frequency. When receiving an unclear transmission, pull out the knob and rotate in either direction to give a natural voice quality. Then push the knob in, the clarifier control should be left in the inner position.

(c.) Methods of Operation (Frequency Selection). The HF system has two methods of operation The first method is called direct tuning (frequency agile). The second method is a channelized operation in which desired operating frequencies are preset, stored and referenced to a channel number.

(1) Direct tuning (simplex only). Each digit of the frequency may be selected instead of dialing up or down to a frequency. The larger concentric knob is used to select the digit to be changed. This digit will flash when selected. Rotation of the knob moves the flashing cursor in the direction of rotation. After the digit to be changed is flashing, the smaller concentric knob is used to select the numeral desired. This process is repeated until the new frequency has been selected. The flashing cursor may then be stowed by moving it to the extreme left or right of the display and then one more click. This stows the cursor behind the display until needed again. The cursor may be recalled by turning the concentric knob one click left or right.

(2) Channel programming. The long distance propagation of HF signals depends on such factors as atmospheric conditions, conditions in the ionosphere, the time of day, and the frequency being used. Therefore, whenever possible, the 99 preset channels should be chosen so that communications with each of several stations along the route is possible on three or more frequencies spaced out well across the HF band. Then if there is some difficulty in communicating with a station on one frequency, other frequencies that station is guarding may be tried without having to set up a frequency digit by digit.

There are three ways to set up a channel: Receive only, simplex, and semi-duplex. To gain access to channelized operation, depress FREQ/CHAN button. To utilize the existing programmed channels (i.e. no programming required) use the small control knob to select the desired channel number. Then momentarily key the microphone to tune the antenna coupler. If channel programming is required, it is necessary to activate the program mode as follows. With the FREQ/CHAN button in (CHAN), use a pencil or other pointed object to push the PGM button in. The button is an alternate action switch: push-on, push-off. The letters PGM will appear in the lower part of the display window and the system will remain in the program mode until the PGM button is pressed again.

(a.) Receive only.

1. Stow the cursor if a frequency digit is flashing.
2. Select the channel to be preset.
3. Set the desired operating mode (LSB,USB,or AM).
4. Set the desired frequency (refer to direct tuning).
5. Push and release STO button once.

NOTE

T will flash in the display window, however a receive only frequency is being set. The flashing T should be ignored.

NOTE

If another channel is to be set, the cursor must be stowed before a new channel can be selected. Use the smaller concentric knob to select the channel and repeat the steps for selecting a new frequency.

6. To return to an operating mode, push the PGM button.

(b.) Simplex. Setting a channel up for simplex operation (receive and transmit on the same frequency).

1. FREQ/CHAN button in (cursor stowed).
2. PGM button in (PGM displayed).
3. Select channel to be preset.
4. Set mode (LSB,USB or AM).
5. Set desired frequency (refer to direct tuning).

6. Push and release STO button twice.

NOTE

The first press of the STO button stores the frequency in the receive position and the second press stores the same frequency in the transmit position. The second push also stores the cursor.

If another channel is to be reset, use the smaller concentric knob to select the channel and repeat the steps for selecting a new frequency. The cursor was automatically stowed. To return to one of the operating modes, push the PGM button again.

(c.) Semi-duplex. Setting a channel for semi-duplex (transmit on one frequency and receive on another).

1. Select channel to be preset.
2. Set desired frequency (refer to direct tuning).
3. Set mode (LSB,USB, or AM).
4. Push STO button once.
5. Set transmit frequency.
6. Push STO button again.

If another channel is to be reset, use the smaller concentric knob to select the channel and repeat the steps.

7. To return to an operating mode, push the PGM button.

NOTE

The mode for each channel (LSB,USB or AM) is stored along with the frequency. If the mode is changed, the system will receive and transmit in the mode selected for transmit.

d. Operating Procedures.

1. AVIONICS MASTER switch - ON.
2. OFF-VOLUME switch - Turn clockwise out of OFF position. Adjust volume as desired.
3. Squelch - Adjust as desired.
4. Clarifier - Adjust as desired.
5. Mode of operation - Select.
6. Frequency/channel - Set/select/program as desired.

e. Shutdown Procedures.

1. OFF-VOLUME switch - OFF.
2. AVIONICS MASTER switch - OFF.

3-12. Radio Telephone (KT 96) (Optional).

a. Description. The radio telephone is installed directly behind the copilot's seat. Its 10 watts of UHF transmitting power provides full line-of-sight range. Range depends on the aircraft's altitude. A range of 110 miles is typical at an altitude of 10,000 feet. The unit incorporates 12 two-way channels, plus one signalling channel on which the telephone listens for any incoming calls. The radio telephone rings incoming calls through the cabin speakers. If the call is not answered after forty five seconds, the radio telephone stops ringing and goes back to listening on the signalling channel. Power is provided to the unit through a 5-ampere circuit breaker, placarded TELEPHONE, located on the copilot's circuit breaker panel.

b. Controls and Functions.

(1) Volume control knob. The volume (VOL) control knob allows for adjustment of audio.

(2) Indicator light. The red indicator light will illuminate when the handset is removed from the cradle, and the CHAN SEL button is pressed.

(3) Hang up button. Pressing the HANG UP button disconnects any incomming calls. If you are unable to answer a incomming call, press the HANG UP button. This however, will require the caller to replace his call.

(4) Channel display window. Displays a channel number as selected by the channel selector knob. Channel numbers are derived from a map of ground-air telephone facilities. This map is available from King Radio Corporation. Although, it is easier to use the ground station map for reference, you can locate a receivable station by rotating the channel selector knob listening to each channel, until a dial tone is heard.

(5) Channel selector knob. The channel selector knob is used to position the desired channel number in the channel display window.

(6) Cradle. The cradle is used to store the handset. It incorporates a spring loading feature, which keeps the handset firmly in place. Placing the handset in the cradle will disconnect calls.

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(7) Handset. The handset provides for transmitting and receiving calls.

(8) Press-to-talk button. For proper operation the press-to-talk button must be pressed while talking into the handset. Release the button while listening (receiving). The press-to-talk button is also used to summon the ground station operator when placing a radio telephone call.

c. Operating Procedures.

(1) To make a call. First check your ground service station map to determine the channel number of the ground station within range, then proceed as follows:

1. Handset - Remove from cradle.
2. CHAN SET button - Press.
3. Channel selector knob - Rotate to select desired channel number in channel display window and listen for a dial tone.

NOTE

If a ground service station map is not available, rotate through the channel numbers until a dial tone is received.

4. Press-to-talk button - Press momentarily to summon operator. When the operator responds, place call giving your city of registry, your phone number and the number you wish to call.

(2) To answer a call.

1. Handset - Remove from cradle.
2. Press-to-talk button - Press and answer call.

(3) To end a call.

1. Handset - Place in cradle, or press HANG UP button.

SECTION III. NAVIGATION

3-13. Description.

The overall navigation equipment group provides the pilot and copilot with the instrumentation required to establish and maintain an accurate flight course and position, and to make an approach under instrument meteorological conditions (IMC). The navigation configuration includes equipment for determining altitude, attitude, position, destination range and bearing, heading reference, groundspeed, and drift angle.

3-14. Radio Magnetic Indicators (RMI).

a. Description. Identical KNI 582 RMI indicators are installed for the pilot and copilot (fig. 3-6). Each RMI provides aircraft heading and radio bearing information to/from a VOR, ADF facility or RNAV waypoint. Selector switches on the RMI provides selection of either VOR or ADF as the information to be displayed on either or both needles. The single needle points to either a tuned NAV 1 VOR or ADF, while the double needle points to either a tuned NAV 2 VOR or ADF navaid. Both RMI's are protected by 1-ampere circuit breakers located on the DC J-BOX in the nose avionics compartment.

b. Controls and Functions.

(1) Warning flag. Indicates loss of heading signal, or that bearing information is unreliable.

(2) Compass card Gyro stabilized to indicate aircraft heading and bearing information.

(3) Heading index Reference point for aircraft heading.

(4) Double needle pointer. Indicates ADF or NAV 2 VOR bearing as selected by double needle switch.

(5) Single needle pointer. Indicates ADF or NAV 1 VOR bearing as selected by single needle switch.

(6) Double needle switch. Selects desired signal to be displayed on double needle pointer.

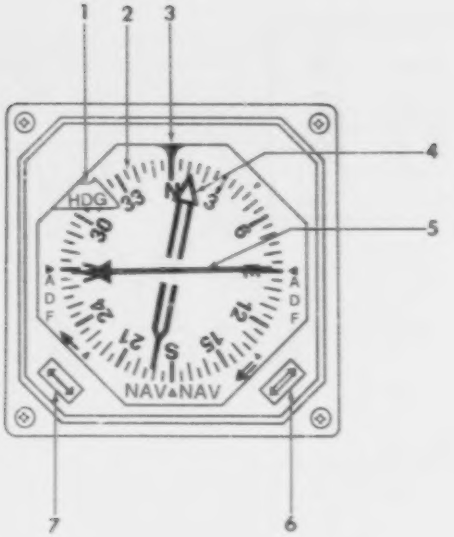
(a.) ADF position. Selects ADF bearing information.

(b.) NAV position. Selects VOR bearing information.

(7) Single needle switch. Selects desired signal to be displayed on single needle pointer.

(a.) ADF position. Selects ADF bearing information.

(b.) NAV position. Selects VOR or RNAV waypoint bearing information.



1. HDG warning flag
2. Compass card
3. Heading index
4. Double needle pointer
5. Single needle pointer
6. Double needle switch
7. Single needle switch

Figure 3-6. Radio Magnetic Indicator (RMI)

3-15. Gyromagnetic Compass Systems.

a. Description. The aircraft incorporates two gyromagnetic compass systems. The pilot's compass system consists of the following components: KSG 105 slaved directional gyro, KMT 112 magnetic flux valve, and a KA 51B slave control (fig. 3-7) (located on left side of pilot's instrument panel). This system provides primary heading data to the pilot's HSI (KPI 553) and copilot's RMI (KNI 582).

The copilot's compass system consists of the following components: KG 102 directional gyro, KMT 112 magnetic flux valve and a KA 51B slave control (fig. 3-7) (located on right side of copilot's instrument panel). This system provides primary heading data to the copilot's HSI (KI 525A) and pilot's RMI.

For heading reference. two separate modes of operation (FREE/SLAVED) are provided, as selected utilizing the KA 51B slave control. In areas where magnetic references are reliable, the systems should be operated in the SLAVE mode. In this mode, the directional gyro is slaved to the magnetic flux valve which supplies magnetic reference for correction of the apparent drift of the gyro. In FREE mode, the systems are operated as a free gyro. In this mode, latitude corrections are manually introduced using the CCW (counterclockwise) or CW (clockwise) switch.

b. Controls and Functions.

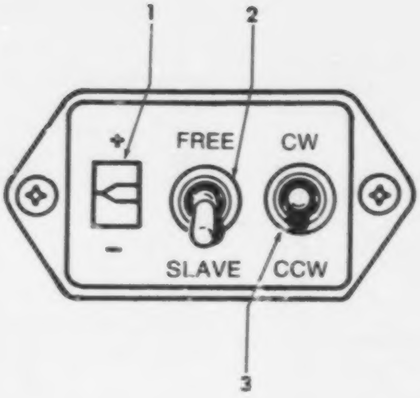
(1) Slave meter. Indicates difference between sensed heading and displayed heading. A positive deflection indicates a clockwise error of the compass card.

(2) SLAVE/FREE gyro switch. When placed in SLAVE position, the system is in the slaved gyro mode. When placed in FREE position, the system is in the free gyro mode.

(3) CCW/CW switch. Placing the switch in the CCW position, when the system is in the free gyro mode, causes the compass card to rotate counterclockwise. When the switch is placed in the CW position, the compass card rotates in the clockwise direction.

3-16. Pilot's Horizontal Situation Indicator.

a. Description. The pilot's horizontal situation indicator (HSI) (fig. 3-8) combines numerous displays to provide a presentation of the aircraft position. The indicator displays the aircraft position relative to a VOR, localizer, glide slope beam, RNAV waypoint, TACAN, and selected heading, with respect to magnetic north. The rotating heading dial is driven by the pilot's compass system. Any



1. Slave meter
2. SLAVE/FREE gyro switch
3 CCW/CW switch

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Figure 3-7. Gyromagnetic Compass Slave Control

warning flag in view indicates that portion of the HSI display is unreliable. In addition, the horizontal situation indicator incorporates a DME readout display. Readout brightness is automatically controlled, with respect to cockpit ambient lighting, by a photocell.

b. Controls and Functions.

(1) DME readout display. Provides a digital display of DME information.

(a.) Distance. Distance to VORTAC or RNAV waypoint is displayed on the left portion of the display, indicated by the legend NM. Distance is indicated to the nearest tenth of a nautical mile, from 0 to 99.9 nautical miles, and to the nearest nautical mile, from 100 to 389 nautical miles.

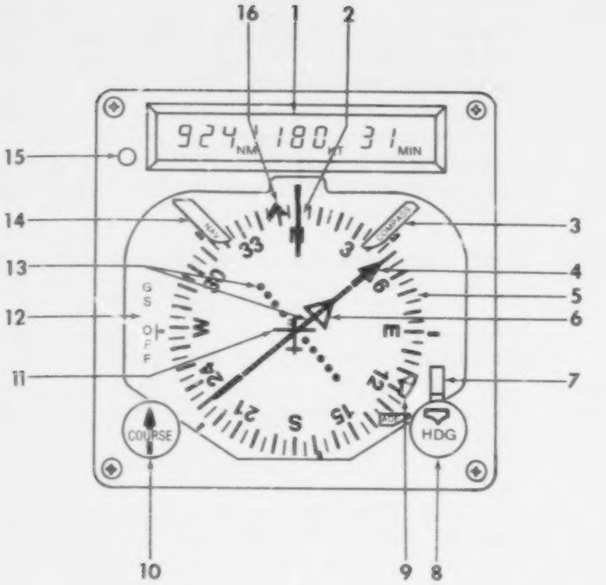
(b.) Groundspeed. Groundspeed. is shown by the middle portion of the display, indicated by the legend KT. It is indicated to the nearest knot from 0 to 999 knots. DME ground speed is only accurate when flying a direct course to or from the VORTAC or RNAV waypoint.

(c.) Time-to-station. Time-to-station (TTS) is displayed by the right portion of the display, indicated by the legend MIN. It is displayed to the nearest minute, from 0 to 99 minutes, with 99 indicated for any longer time-to-station. Time-to-station is only accurate for a course directly to or from a VORTAC or RNAV waypoint.

(d.) Radar altitude. Radar altitude is shown as dashed lines on the middle display between 2500 and 1000 feet, and numerically to the nearest 10 feet from 990 to 0 feet. The appearance of the letters AL on the right side of the display, and the blanking of KT and MIN, indicate radar altitude information is being displayed.

(e.) DME controlling frequency source. The digital display indicates the source of the frequency information which is controlling the DME. Between the left and middle displays, a 1 is displayed when the DME XFER switch is set to NAV 1, likewise 2 when NAV 2 is selected. Switching to HOLD will store the channeling information from the NAV frequency selector which was previously selected. No frequency selector thereafter affects the DME, and any frequency selector may then be set to another frequency. The DME will remain on the frequency being stored until NAV 1 or NAV 2 is selected. 1H or H2 on the display indicates a HOLD setting, as well as the NAV frequency selector whose setting was held.

(f.) RNV display. The indicator will display RNV when the displayed distance, ground-



1. DME readout display
2. Lubber line
3. Compass flag
4. Course pointer
5. Rotating heading dial
6. To-From pointer
7. VOR/ADF switch
8. Heading knob
9. Heading bug
10. Course knob
11. Symbolic aircraft
12. Glideslope deviation pointer/scale
13. Course deviation bar and scale
14. NAV flag
15. Photocell
16. Bearing pointer

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Figure 3-8. Pilot's Horizontal Situation Indicator

speed, and time-to-station are derived from the area navigation system. This RNV legend will flash when HOLD mode has been selected. The display is blanked when RNV is flashing.

(g.) Photocell. The photocell automatically controls readout brightness with respect to cockpit ambient lighting.

(h.) Lubber line. Fixed heading mark.

(i.) Heading bug. The orange heading bug is positioned on the rotating heading dial, by the heading knob, to select and display a preselected compass heading. Once set to the desired heading, the heading bug will maintain its position. The difference between the bug and the fore lubber line represents the heading select error applied to the flight director computer.

(j.) Compass flag. When the compass flag is in view, compass information is not valid.

(k.) Course deviation bar and scale. The yellow course deviation bar represents the centerline of the selected VOR, RNAV, or localizer course. This deviation is depicted as either linear or angular deflection of the course deviation bar.

Angular deviation is displayed in the VOR or TACAN modes. One dot deflection in the VOR or TACAN mode equals 2-degree off course, whereas full scale or 5 dots equals 10-degrees off course. When a localizer frequency is selected, one dot deflection equals 1/2-degree deviation, whereas full scale or 5 dots equals 2 1/2-degree deviation off course.

Linear deflection is displayed in the VOR RNV, VOR RNV APR, TACAN RNV, and TACAN RNV APR modes. When using linear deflection (excluding APR mode), one dot deflection equals one nautical mile off course and five dots equal five nautical miles off course. This deviation is true regardless of distance from the station, therefore depicting linear instead of angular deviation. The aircraft symbol pictorially shows actual aircraft position in relation to this selected course.

(l.) VOR/ADF switch. Selects NAV 1 VOR or ADF bearing information to be displayed by the green VOR/ADF bearing bug.

(m.) Heading knob. Positions the orange heading bug.

(n.) Symbolic aircraft. The fixed miniature aircraft symbol corresponds to the longitudinal axis of the aircraft and lubber line mark. The

symbol shows aircraft position and heading with respect to the rotating heading dial, and aircraft position in relation to a radio course.

(o.) Course knob. Positions the yellow course pointer.

(p.) Glide slope deviation pointer/scale. The glide slope pointer displays glide slope deviation. The pointer is in view only when tuned to a localizer frequency. If the aircraft is below glide slope path, the pointer is displayed upward on the scale. Each dot on the scale represents approximately 0.4 degrees displacement.

(q.) To-from pointer. The to-from pointers, aligned on the course pointer, are located 180 degrees apart. One always points in the direction of the station, along the selected VOR, TACAN, or RNAV waypoint radial.

(r.) Rotating heading dial. Displays gyro stabilized magnetic compass information. The heading dial rotates with the aircraft throughout 360 degrees. The rotating heading dial is driven by the pilot's compass system.

(s.) Navigation flag. When the navigation flag is in view, the NAV portion of the system is not valid.

(t.) Course pointer. The yellow course pointer is positioned on the heading dial by the course knob, to a magnetic bearing that coincides with the selected course being flown. The course pointer is also positioned by RNAV, or flight director system modes of operation. The course pointer rotates with the heading dial to provide a continuous readout of course error to the computer.

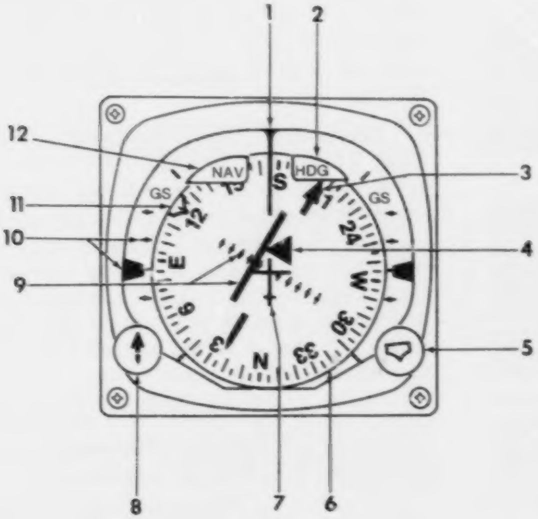
3-17. Copilot's Horizontal Situation Indicator.

a. Description. The copilot's horizontal situation indicator (HSI) (fig. 3-9) operates independently from the pilot's. It combines numerous displays to provide a presentation of the aircraft position. The indicator displays aircraft displacement relative to VOR or localizer course, VOR/localizer deviation, glide slope deviation, and selected headings with respect to magnetic north. Deviation displacement is always angular. Any warning flag in view indicates that portion of the HSI display is unreliable. The rotating heading dial is driven by the copilot's compass system.

b. Controls and Functions.

(1) Lubber line. Fixed heading mark.

(2) HDG warning flag. Indicates loss of reliable heading information.



1. Lubber line
2. HDG warning flag
3. Course pointer
4. To-From pointer
5. Heading select knob
6. Rotating heading dial
7. Symbolic aircraft
8. Course select knob
9. Course deviation bar and scale
10. Glideslope pointer and scale
11. Heading bug
12. NAV warning flag

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Figure 3-9. Copilot's Horizontal Situation Indicator

(3) Course pointer. The yellow course pointer is positioned on the heading dial by the course knob to select a magnetic bearing that coincides with the desired VOR radial or localizer course.

(4) To-from pointer. The to-from pointers, aligned on the course pointer, are located 180 degrees apart. One always points in the direction of the station.

(5) Heading select knob. Positions the orange heading bug.

(6) Rotating heading dial. Displays gyro stabilized magnetic compass information. The heading dial rotates with the aircraft throughout 360°. The copilot's compass system provides power to drive the rotating heading dial.

(7) Course select knob. Positions the yellow course pointer.

(8) Course deviation bar and scale. The yellow course deviation bar represents the centerline of selected VOR or localizer courses. The symbolic aircraft pictorially shows the actual aircraft position in relation to this selected course. In VOR operation, each dot represents 2-degree deviation from the centerline, whereas 5 dots represent 10-degree deviation off course. In ILS operation, each dot represents 1/2-degree deviation from the centerline, whereas 5 dots represent 2 1/2-degree deviation off course.

(9) Symbolic aircraft. The fixed miniature aircraft symbol corresponds to the longitudinal axis of the aircraft and lubber line markings. The symbol shows the aircraft position and heading with respect to a radio course and the rotating heading dial.

(10) Glide slope pointer and scale. The dual glide slope displays glide slope deviation. The pointer is in view only when tuned to and receiving a localizer frequency. If the aircraft is below glide slope, the pointer is displayed upward on the scale. Each increment on the scale indicates an approximate 0.4 degree deviation from the glide slope.

(11) Heading bug. The orange heading bug is positioned on the rotating heading dial by the heading knob, and displays preselected compass heading. The bug rotates with the heading dial.

(12) NAV warning flag. Indicates loss of NAV 2.

3-18. Course Deviation Indicator (KI 204) (Optional).

a. Description. The course deviation indicator when interfaced with the NAV 2 receiver (KN 53), provides rectangular display of VOR/localizer, and glideslope deviation. The indicator incorporates separate and independent to/from flags, and warning flags for both VOR/localizer, and glideslope. The course deviation indicator is protected through a 2-ampere circuit breaker, placarded NAV 2, located on the lower right subpanel.

b. Controls and Functions.

(1) Course deviation pointer. The course deviation pointer displays the aircraft's position relative to the omni (VOR) course, or localizer (LOC) course. When tracking a VOR course, each dot represents 1-degree of deviation. When on a LOC course, each dot represents 1/2-degree of deviation.

(2) VOR/localizer warning flag. The NAV warning flag will display whenever the VOR or localizer frequency is unreliable.

(3) To-from flags. They operate only with a usable VOR or localizer signal. The white TO/FR flags indicate whether the selected course is to or from a station. When receiving a reliable localizer signal, the TO flag will be in view.

(4) Omni-bearing course card. The card is rotated by the OBS knob for selection of a desired VOR/localizer course.

(5) Omni-bearing selector (OBS) knob. The OBS knob is used to set a desired VOR/localizer course under the course index.

(6) Glideslope deviation pointer. The glideslope deviation pointer displays the aircraft's position relative to the glideslope. Each dot represents 1/10-degree deviation from the glideslope. The pointer is offset 15-degrees for correct viewing.

(7) Glideslope (GS) warning flag. The glideslope warning flag will display whenever the glideslope frequency is unreliable.

3-19. Pilot's Flight Director Indicator.

a. Description. The pilot's flight director indicator (FDI) (fig. 3-10) combines the attitude sphere display with computed steering information to provide the commands required to intercept and maintain a desired flight path. All guidance commands are depicted through the use of a command bar arrangement. Warning flags are provided to indicate invalid attitude or computed command displays. Any warning flag in view indicates that portion of information is unreliable.

b. Controls and Functions

(1) Roll attitude scale. Displays actual roll attitude through a movable pointer and fixed reference marks.

(2) Roll attitude pointer. Rotates with attitude sphere, indicating roll attitude.

(3) Decision height annunciator. illuminates upon reaching altitude selected on the altitude preselect/alerter.

(4) Attitude sphere. Moves with respect to the symbolic aircraft reference to display actual pitch and roll attitude. Pitch attitude marks are in 5-degree increments on a blue and brown sphere.

(5) Command bar. The three-dimensional command bar displays the computed steering commands to intercept and maintain a desired flight path. The bar moves up or down to present pitch commands and rotates clockwise or counterclockwise for roll commands. The command bar will bias out of view and ATTITUDE/COMPUTER flags will display, whenever the FD mode is not selected and/or when flight director internal power is inadequate.

(6) Computer flag. When in view, indicates the system is receiving unreliable flight computer data.

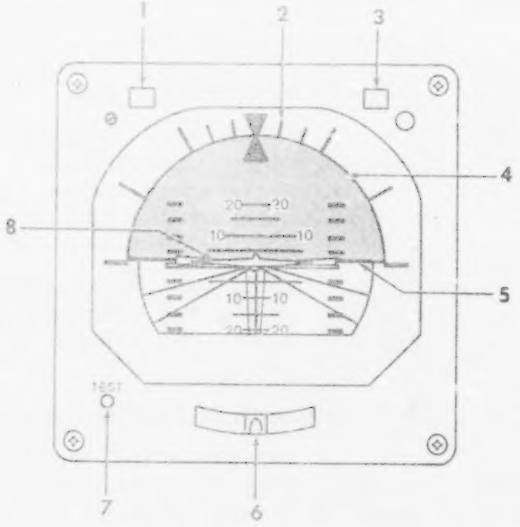
(7) Inclinometer. Provides the pilot a conventional display of aircraft slip or skid. Used as an aid to coordinate maneuvers.

(8) Attitude flag. When in view, indicates the system is receiving unreliable vertical gyro data.

(9) Attitude horizon test switch. When the test switch is pressed, the ATTITUDE and COMPASS flags will appear and the pictorial horizon will display a climbing right turn.

(10) Symbolic aircraft. Serves as a stationary symbol of the aircraft. Aircraft pitch and roll attitudes are displayed by relationship between the fixed miniature aircraft and movable sphere. The symbolic aircraft is flown to align the command bar to the aircraft symbol, in order to satisfy commands of the selected flight director mode.

(11) RNAV annunciator. Illuminates when navigation is being controlled by the flight director, in NAV or APPR mode.



1. RNAV annunciator
2. Roll attitude scale
3. Decision height annunciator
4. Attitude sphere
5. Command bar
6. Inclinometer
7. Attitude horizon test switch
8. Symbolic aircraft

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Figure 3-10. Pilot's Flight Director Indicator

3-20. Copilot's Attitude Director Indicator.

a. Description. The copilot's attitude director indicator (ADI) (fig. 3-11) displays aircraft attitude as a conventional pneumatically operated attitude gyro. Attitude displayed is in relationship to an artificial horizon. The instrument is equipped with a DH (decision height) annunciator, which works in conjunction with the radar altimeter. Pneumatic power to drive the gyro is obtained from the aircraft pneumatic system.

b. Controls and Functions.

(1) Roll attitude index. Displays aircraft roll attitude, as read against the roll attitude scale.

(2) Roll attitude scale. Displays actual roll attitude from 0, 10, 20, 30, 60, and 90 degrees.

(3) Attitude sphere. Moves with respect o the symbolic aircraft reference to display actual pitch and roll attitude. Pitch up and down marks are n 5-degree increments divided by an artificial horizon.

(4) Symbolic aircraft. Serves as a stationary symbol of the aircraft. Aircraft pitch and roll ttitudes are displayed by the relationship between he fixed miniature aircraft and the movable sphere.

(5) Symbolic aircraft alignment knob. Provides manual positioning of the symbolic aircraft for pitch attitude alignment.

(6) Decision height (DH) annunciator. Illuminates when the aircraft descends below a selected decision height, as set on the radio altimeter indicator.

3-21. Turn and Bank Indicators.

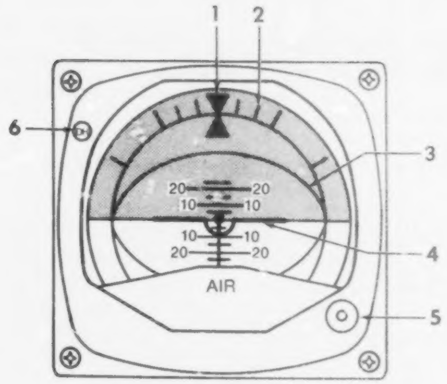
a. Description. Two independently operated turn and bank indicators are installed separately on the pilot's and copilot's sides of the instrument panel. The pilot's unit is operated by DC power and is protected by a 5-ampere circuit breaker, placarded T&B, located on the copilot's subpanel. The copilot's turn and bank is pneumatically operated.

b. Controls and Functions.

(1) Turn rate indicator. Indicates direction and rate of turn. A two minute turn rate is indicated when the turn rate indicator is deflected one needle width to the left or right of the index.

(2) Index. A reference mark for alignment of the turn rate indicator.

(3) Inclinometer. Indicates lateral acceleration (slip skid) of aircraft.



1. Roll attitude index
2. Roll attitude scale
3. Attitude sphere
4. Symbolic aircraft
5. Symbolic aircraft alignment knob
6. Decision height annunciator

AP011652

Figure 3-11. Copilot's Attitude Director Indicator

3-22. Radar Altimeter Indicator.

a. Description. The KI 250 radar altimeter indicator (fig. 3-12) displays actual altitude of the aircraft from 2500 feet above ground level (AGL) to touchdown. The indicator is protected by a 1-ampere circuit breaker, placarded RADAR ALT, located on the copilot's circuit breaker panel.

b. Controls and Functions.

(1) Decision height (DH) annunciator. The decision height (DH) annunciator will illuminate when the aircraft is at or below the selected decision height.

(2) Altitude pointer. The altitude pointer will point to the existing altitude.

(3) Decision height bug. The decision height bug is set to the desired decision height, by the decision height set knob

(4) Altitude scale. The altitude scale is shown in one hundred feet increments, from 0 to 2500 feet AGL.

(5) Decision height set knob. The decision height set knob is used to set the decision height bug.

3-23. Altitude Select Controller.

a. Description. The altitude select controller (fig. 3-13) provides a means of selecting and displaying the desired altitude reference for altitude alerting and altitude capture. It is protected through a 1-ampere circuit breaker, placarded ALT ALERT, located on the copilot's circuit breaker panel.

b. Controls and Functions.

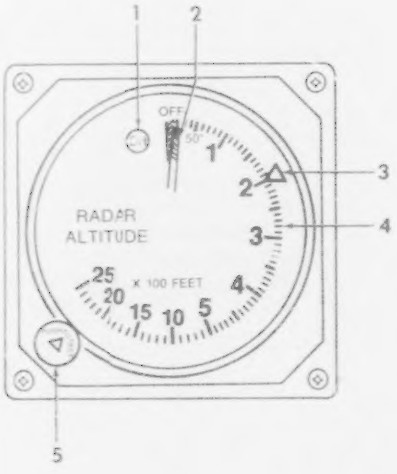
(1) Altitude ARM switch. Pressing the ARM (altitude arm) switch arms the altitude select controller. ARM annunciation will display in the display window. The ALT ARM annunciator, located in the flight director mode annunciator panel on the pilot's instrument panel (fig. 2-22), will be illuminated.

Within approximately 1000 feet of the preselected altitude, ALERT will be displayed in the display window and will remain displayed until reaching approximately 300 feet of the selected altitude.

(2) Selected altitude display. Displays altitude selected with altitude select knob.

(3) Altitude select knob.

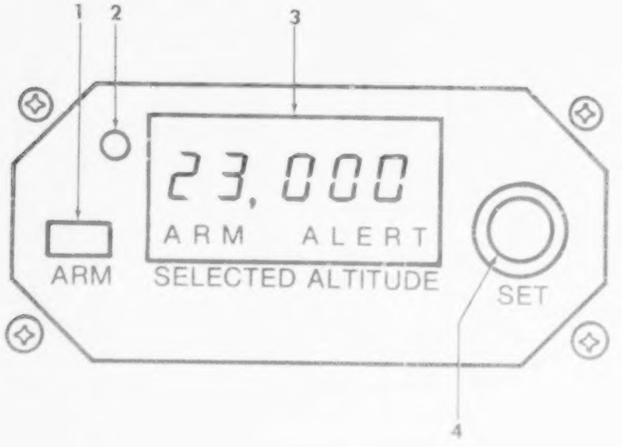
(a.) Inner knob. Used to select 100 foot increments of desired altitude.



1. Decision height annunciator
2. Altitude pointer
3. Decision height bug
4. Altitude scale
5. Decision height set knob

AP011851

Figure 3-12. Radar Altimeter Indicator



1. Altitude ARM switch
2. Altitude ARM annunciator
3. Selected altitude display
4. Altitude select knob

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Figure 3-13. Altitude Select Controller

(b.) Outer knob. Used to select 1000 foot increments of desired altitude.

(4) Altitude alert annunciator. Will display when the aircraft is within approximately 1000 feet, and will extinguish when reaching/deviating approximately 300 feet of the selected display.

(5) Altitude arm annunciator. The ARM annunciator will display when altitude ARM has been selected.

3-24. NAV 1 Receiver (KNS 81).

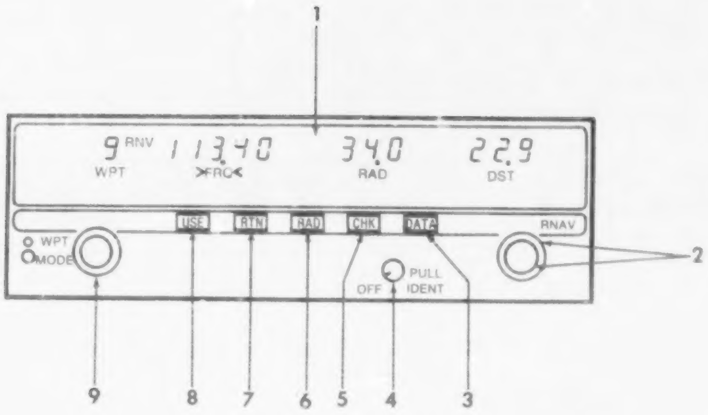
a. Description. The KNS 81 is a self-contained navigation system consisting of a 200-channel VOR/LOC receiver, a 40-channel glideslope receiver, and a digital RNAV computer with preselection storage capability and display of 10 NAV frequencies (fig. 3-14). The receiver interfaces with the pilot's TACAN/DME, displaying bearing information on the HSI and RMI. It receives and interprets VHF omnidirectional radio range (VOR) and localizer (LOC) signals in the frequency range of 108.00 to 117.95 MHz; glideslope signals in the frequency range of 329.15 to 335.00 MHz; and marker beacon signals to 75 MHz.

The system incorporates three TACAN modes (TAC, TAC RNV, TAC RNV APR), three VOR modes (VOR, VOR RNV, and VOR RNV APR), and an ILS mode. System flexibility is maintained with CHK and RAD buttons. The CHK button, when pressed, permits a momentary display of the TAC/VOR radial and DME distance information in the display window. The RAD button when pressed permits displaying the radial (in place of ground speed) from the VORTAC or waypoint in the DME indicator.

In addition, the KNS 81 tunes the KTU 709 DME/TACAN system to 252 (126X and 126Y) TACAN channels. The system is protected through a 3-ampere circuit breaker, placarded NAV 1, located on the copilot's subpanel. DME is protected through a 2-ampere circuit breaker, placarded DME, located on the copilot's circuit breaker panel.

b. Controls and Functions.

(1) System status displays. Mode annunciation displays the mode (VOR, VOR/RNV, VOR/RNV/APR, TAC, TAC/RNV, TAC/RNV/APR) that is active.



1. System status displays
2. Data input knobs
3. DATA button
4. Power OFF PULL IDENT volume contr
5. CHK (check) button
6. RAD (radial) button
7. RTN (return) button
8. USE button
9. Waypoint select knob

AP011849

Figure 3-14. NAV 1 Receiver

NOTE

When an ILS frequency is selected in a VOR mode, the system automatically goes into the ILS mode regardless of the VOR mode annunciated.

(2) WPT (waypoint) display. Shows the number of the waypoint data storage bin that is being displayed in the display window. When the displayed waypoint number is different from the active waypoint, the WPT will blink.

(3) Caret display (‡ °). Indicates the waypoint parameter (frequency or channel, radial, or distance) that the data input knobs are controlling. The caret display cycles from FRQ to RAD to DST and back to FRQ as the data button is pressed.

(4) FRQ (frequency) display. Shows the frequency entered into the system for VOR, VORTAC, or localizer stations with the data input knobs. When in a TACAN mode, the channel number is displayed. When selecting a frequency or channel, the carets must be at the FRQ display. When the system is first turned on, the information being displayed prior to the last shutdown will be displayed again.

(5) RAD (radial) display. Shows the VORTAC or TACAN station radial on which the waypoint is located.

NOTE

In the VOR or TAC mode, this display will show dashes to indicate that RNAV radial information is irrelevant. The value is selected by the data input knobs when the caret is at the RAD display. When the CHK button is pressed, this area will display the radial from the VORTAC or TACAN station to the aircraft.

(6) DST (distance) display. Shows the distance the waypoint is offset from the VORTAC or TACAN station.

NOTE

In the VOR or TAC mode, this display will show dashes to indicate that RNAV distance information is irrelevant.

Its value is selected by the data input knobs when the caret is at the DST display. This area will display the distance from the VORTAC or TACAN station to the aircraft when the CHK button is pressed.

(7) Data input knobs. Two concentric knobs used for selection of VOR/LOC frequency or TACAN channel, waypoint radial, and waypoint distance. DME and TACAN are channeled with selection of the paired VOR frequency or TACAN channel. The internal glideslope is channeled with selection of the paired LOC frequency. Turn these knobs to enter desired data into the RNAV computer as follows:

(a.) Frequency/channel selection. In a VOR mode, the large knob controls the 10 and 1 MHz digit in the display. The small knob controls the 0.1 and 0.05 MHz digit and selects FRQ in 0.05 MHZ steps in either the in or out position. P2 In a TACAN mode, the large knob controls the 10 and 100 digits in the display. The small knob controls the 1 digit in the in position and x or y selection in the out position. If the unit is displaying an illegal channel, i.e., 00 or 127 through 129, the FRQ will flash.

(b.) Radial selection. The large knob changes the 10-degree and 100-degree digit of the display. The small knob changes the 1-degree digit in the inner position and the 0.1-degree digit in the outer position.

(c.) Distance selection. The large knob changes the 100 and 10 nautical mile digit of the display. The small knob changes the 1 nautical mile digit in the in (inner) position and the 0.1 nautical mile digit in the out (outer) position.

(8) DATA button. The momentary push button placarded, DATA, moves the caret (‡ °) display from FRQ to RAD to DST and back to FRQ, providing a visual reference of which waypoint parameter the data input knobs are addressing.

(9) Power OFF PULL IDENT volume control. Turn clockwise for power on and volume increase. Pull out for VOR/LOC IDENT tone. In TACAN modes, this audio is muted and the station is identified by selecting DME on the audio panel.

(10) CHK (check) button. Pressing this momentary push-button displays the aircraft's position from a VORTAC or TACAN by replacing the RAD and DST waypoint parameters normally displayed with the radial and distance from the VORTAC or TACAN station.

(11) RAD (radial) button. This two-position button is normally operated in the outer position. When depressed (inner position), the remote digital DME indicator will display the radial you are on (from the active waypoint, VORTAC, or TACAN station) instead of groundspeed and time-to station. This feature becomes inoperative in DME hold mode or when the DME is tuned by another NAV receiver.

(12) RTN (return) button. A momentary push button that switches the display to the active waypoint, VORTAC, TACAN, or ILS frequency. This button is used after entering new data for other waypoints, and you desire returning to navigation data presently in use.

(13) USE button. After calling up a previously entered RNAV waypoint, VORTAC, TACAN, or ILS frequency with the waypoint select knob, depressing this momentary push button will put in use that waypoint, VOR, VORTAC, TACAN, or ILS frequency.

(14) Waypoint select knob. Selects any one of ten data storage bins in which VOR/LOC frequencies or TACAN channels, with or without waypoint coordinates, have been inserted. Each storage bin can be called up as required from 0 through 9, or 9 through 0.

(15) Mode select knob. This knob selects one of the six available modes of operation. Modes are: VOR (direct to or from a VOR or VORTAC station with angular course width deviation). VOR/RNAV (direct to waypoint with linear crosstrack deviation ±5 nautical mile). VOR/RNV/APR (direct to waypoint with linear crosstrack deviation ±1.25 nautical mile). TAC (direct to or from VORTAC or TACAN station with angular course width deviation). TAC/RNV (direct to waypoint with linear crosstrack deviation ±5 nautical mile). TAC/RNV/APR (direct to waypoint with linear crosstrack deviation ±1.25 nautical mile).

When an ILS frequency is entered, with the system in a VOR mode, the system will automatically go to the ILS mode. When the ILS frequency is removed, the system will revert back to the VOR mode it was in previously. Some TACAN channels correspond to ILS frequencies. Selecting a TACAN mode will allow full use of these channels without the system reverting to ILS mode.

c. Operating Procedures.

1. AVIONICS MASTER Switch - ON.
2. OFF PULL IDENT Switch - Turn clockwise out of detent. Adjust volume as required.
3. Mode of Operation - Select as required.
4. Waypoint - Select as required.
5. Tacan Channel - Verify, if in a TAC mode.

6. Frequency - Verify, if in a VOR, VORTAC, or ILS mode.
7. Station Ident - Check as follows:
   a. TACAN - Select DME audio.
   b. VOR - Pull out OFF PULL IDENT switch. Push in after identification has been made.

d. Shutdown Procedures.

1. OFF PULL IDENT Switch - Turn counterclockwise into the off position.
2. AVIONICS MASTER Switch - OFF.

3-25. NAV 2 Receiver (KN 53).

a. Description. The KN 53 NAV 2 receiver (fig. 3-15) is capable of being tuned to all 200 VOR/LOC frequencies from 108.00 to 117.95 MHz, and receive all 40 glideslope channels. Navigation information is displayed on the copilot's HSI. The receiver allows for selecting and storing two frequencies, USE and STBY. These frequencies are displayed at all times. Both frequencies are provided with storage, which protects them from loss during power interruptions. Power for the receiver is routed through a 2-ampere circuit breaker placarded NAV 2, located on the copilot's subpanel.

b. Controls and Functions.

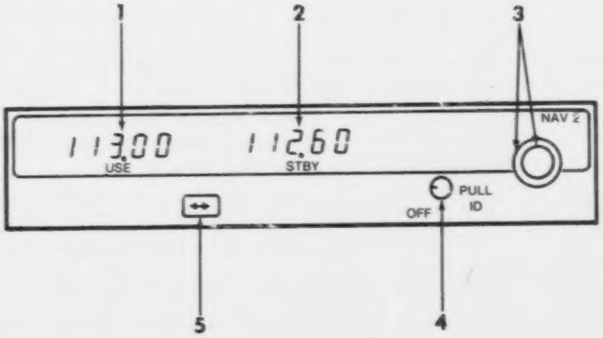
(1) USE display. The active frequency tuned to. This frequency is first tuned into the STBY position, then transferred to the USE position by pressing the frequency transfer button.

(2) STBY display. A standby frequency (if selected) will display in the STBY window.

(3) Frequency selector knobs. The outer knob tunes the MHz portion of the frequency. The smaller knob tunes the kHz portion in 50 kHz steps. By rotating the frequency selector knobs either clockwise or counterclockwise, the desired operating frequency is programmed into the standby (STBY) display window. A clockwise rotation will increase the displayed frequency number, while a counterclockwise rotation will decrease it.

(4) OFF PULL ID knob. Rotating the OFF PULL ID knob clockwise from the detented off position applies power to the unit. No warm up time is required. Further rotation of the knob increases NAV signal volume. NAV voice is heard when the knob is pushed in. When the knob is pulled out, the identification (ID) signal, and voice may be heard.

(5) Frequency transfer button. When pressed, the frequency transfer button will transfer the displayed standby frequency into the USE posi-



1. USE frequency display
2. STBY frequency display
3. Frequency selector knobs
4. OFF PULL ID knob
5. Frequency transfer button

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Figure 3-15. NAV 2 Receiver

tion and moves the displayed USE frequency to the STBY (standby) position.

c. Operating Procedure.

1. AVIONICS MASTER Switch - ON.
2. OFF PULL ID Knob - Turn knob clockwise out of off (detent). Increase volume by further rotation of knob.
3. Frequencies - Select. Insure desired active frequency is in USE display.
4. Identify Station - As required.

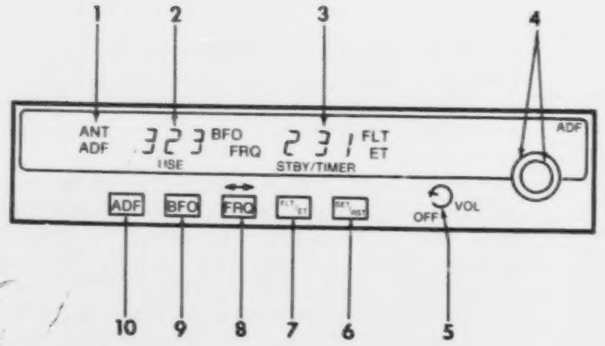
d. Shutdown Procedure.

1. OFF PULL ID Knob - Turn counterclockwise to off (detent).
2. AVIONICS MASTER Switch - OFF.

3-26. ADF Radio (KR 87).

a. Description. The KR 87 automatic directional finder is a digitally tuned solid state receiver which provides bearing information to stations in the 200 kHz to 1799 kHz frequency band, along with audio reception (fig. 3-16). The unit displays the active frequency in the left display window. The right window will display either the stand-by frequency (which can be transferred to the active window), or a flight timer, or programmable elapsed timer. The flight timer will keep track of the total flight time, while the independent programmable elapsed timer can be reset to count up from zero or be preset to a value and count down to zero. The system is protected by a 1-ampere circuit breaker, placarded ADF, located on the right subpanel. The antenna located on the lower side of the aircraft (fig. 2-1), contains both loop and sense antennas, preamplifiers, and modulators, which combine the antenna signals into a single RF signal which is output to the receiver via a triaxial cable.

b. Operating Modes. The automatic directional finder (ADF) has two operational modes. In the ANT (antenna) mode, the loop antenna is disabled, and the unit acts as a receiver, allowing audio reception through the speaker or headphones. The indicator needle as selected on the RMI's will park at a 90-degree relative position and the ANT message on the left side of the display window will display. This mode will provide a slightly clearer audio reception, and is used for station identification. In various parts of the world, some L/LM stations use an interrupted carrier for identification purposes. A beat frequency oscillator (BFO) function is provided to permit these stations to be more easily identified. Pushing the BFO switch (fig. 3-16) will cause a 1000 Hz tone to be heard whenever there is a radio car-



1. Mode display
2. USE frequency display
3. STBY/TIMER display
4. Frequency select knobs
5. OFF/VOL control switch
6. SET/RST button
7. FLT/ET button
8. FRQ button
9. BFO button
10. ADF button

AP011847

Figure 3-16. ADF Radio

rier signal present at the selected frequency. It will also light the BFO message in the center of the display.

With the ADF button depressed, the unit is placed into the ADF mode and the loop antenna is enabled. The ADF message on the left side of the window display will display and the indicator needle as selected on the RMI's will point to the relative bearing of the selected station. In order to tell if there is a sufficient signal for navigational purposes, place the unit back in the ANT mode, parking the indicator needle as selected on the RMI's at 90-degrees. When the unit is then switched to the ADF mode, the needle should slew to the station bearing in a positive manner, without excessive sluggishness, wavering, or reversals.

c. Controls and Functions.

(1) Mode display. Displays operating mode the unit is in.

(2) USE display. Displays frequency which the system is tuned to.

(3) FRQ display. Illuminates when a standby frequency has been inserted for display.

(4) STBY/TIMER display. Displays standby frequency, flight time or elapsed time. The standby frequency is placed in memory when either FLT (flight time) or ET (elapsed time) mode is selected.

(5) FLT/ET display. Flight time or elapsed time are displayed and annunciated alternatively by depressing the FLT/ET button.

(6) Frequency select knobs. Selects active/standby frequencies.

(a.) Active frequency. The active frequency is displayed in the left portion of the window display. This frequency may be changed with the concentric knobs when either time mode (FLT or ET) is being displayed. To set the 10 digit, push the small knob in and rotate it. Clockwise rotation will increment the digit. The digit will roll over at 9 to 0 and roll under (when turning the knob counter-clockwise) at 0 to 9. With the small knob pulled out, the 1's digit may be set. It's operation is the same as for the 10's digit.

Turning the large knob changes the 100's digit and the 1000's digit. The 100's digit carries to the 1000's digit from 9 to 10 and borrows from 10 to 9. The two digits roll over from 17 to 02 and under from 02 to 17, thus limiting the frequencies to the range of 200 kHz to 1799 kHz.

(b.) Standby frequency. The standby frequency is displayed in the right portion of the display window when the FRQ message is displayed. In this case, the standby frequency may be changed with the frequency control knobs as desired. If the standby frequency is not being displayed, it may be called to the window by pressing the FRQ button. Pressing this button when the standby frequency is displayed causes the current standby and active frequencies to be exchanged.

(7) OFF/VOL control switch. Rotating this control switch clockwise out of detent turns the unit on. Further rotation of the control switch increases volume.

(8) SET/RST button. This button controls the elapsed time. Time is reset back to zero each time the button is pressed. The elapsed times has a countdown mode which is set by depressing the SET/RST button for 2 seconds or until the ET display begins to flash. With the ET flashing, the selector knob will set any time up to 59 minutes, 59 seconds. To start the elapsed time count down, press the SET/RST button and the timer will start counting down. At zero the timer will begin to flash for 15 seconds and then go to a solid display. While the FLT or ET are displayed, the in use frequency may be changed with the frequency control knobs.

(9) Timers.

(a.) FLT/ET button. If elapsed time (ET) is currently displayed pressing the FLT/ET button will cause the flight timer (FT) to be displayed. Pressing this button again will exchange the two timers in the display. If the standby frequency is displayed, pressing the FLT/ET button will cause the timer which was last displayed to reappear in the window.

NOTE

When power is first applied the flight timer is displayed.

(b.) Flight timer. The flight timer is displayed in the right portion of the display window when the FLT message is displayed. The timer receives power through the landing gear squat switch. The counter will count up to 59 hours, 59 seconds. It begins counting upon liftoff and will quit counting upon landing. The elapsed timer may be reset back to 0 by pressing the SET/RST button or turning the unit off.

(c.) Elapsed timer. This counter has two modes; count up and count down. When power is applied it is in the count up mode starting at 0. The timer will count up to 59 hours, 59 seconds, displaying minutes and seconds until one hour has elapsed, then displaying hours and minutes. When

in the count up mode, the timer may be reset to 0 by pressing the SET/RST button.

NOTE

> Pressing the reset button will reset the elapsed timer regardless of what is currently being displayed.

To enter the count down mode, the SET/RST button is held depressed for approximately 2 seconds until the ET message begins to flash. While the ET message is flashing the timer is in the ET set mode. In this mode a number up to 59 minutes, 59 seconds may be preset into the elapsed timer with the frequency select knobs. With the smaller knob pressed in, the 10's of seconds digit may be changed; it will roll over from 5 to 0 and under 0 to 5. With the knob pulled out, the 1's of seconds digit may be changed. It rolls over for 9 to 0 and under from 0 to 9. The larger knob modifies the minutes. It rolls over from 59 to 0 and under from 0 to 59. The timer will remain in the ET set mode (ET message flashing) for 15 seconds after a number is set in or until the SET/RST, FLT/ET, or FRQ button is pressed. The preset number will remain unchanged until the SET/RST button is pressed. When the SET/RST button is pressed after a number has been preset, the elapsed timer will start counting down. When the elapsed timer is counting down, pressing the SET/RST button again will have no effect unless it is held for approximately 2 seconds. This will cause the timer to stop and enter the set mode (ET message flashing). When the timer reaches 0 it changes to the count up mode and continues up from 0. The elapsed time will flash for 15 seconds, then annunciate a steady display.

(10) FRQ button. The selected frequency is put into the active window by pressing the FRQ button. The standby and active frequencies will be exchanged.

(11) BFO button. When the BFO button is depressed, the BFO mode is activated and BFO will display in the display window. In various parts of the world, some L/LM stations use an interrupted carrier for identification purposes. When in the BFO mode these stations are more easily identified. Pushing the BFO button will cause a 1000 Hz tone to be heard whenever there is a radio carrier signal present at the selected frequency.

(12) ADF button. When the ADF button is depressed, the unit is placed into the ADF mode with the loop antenna enabled. An ADF message on the left portion of the window will display. Indicator needles, as selected on the RMI's, will point to the relative bearing of the selected station.

d. Operating Procedures.

1. AVIONICS MASTER Switch - ON.
2. OFF VOL Control Switch - Turn clockwise out of detent. Adjust volume as required.

NOTE

> An audio muting feature causes the audio output to be muted unless the receiver is locked onto a valid station. This reduces interstation noise and aids in identifying navigable stations.

3. ADF Test - Select ANT mode. Verify bearing pointers park in the 90-degree position.
4. Operating Mode - Select as desired.
5. Frequencies - Select. Insure desired active frequency is displayed.
6. FLT/ET Switch - Operate as required.

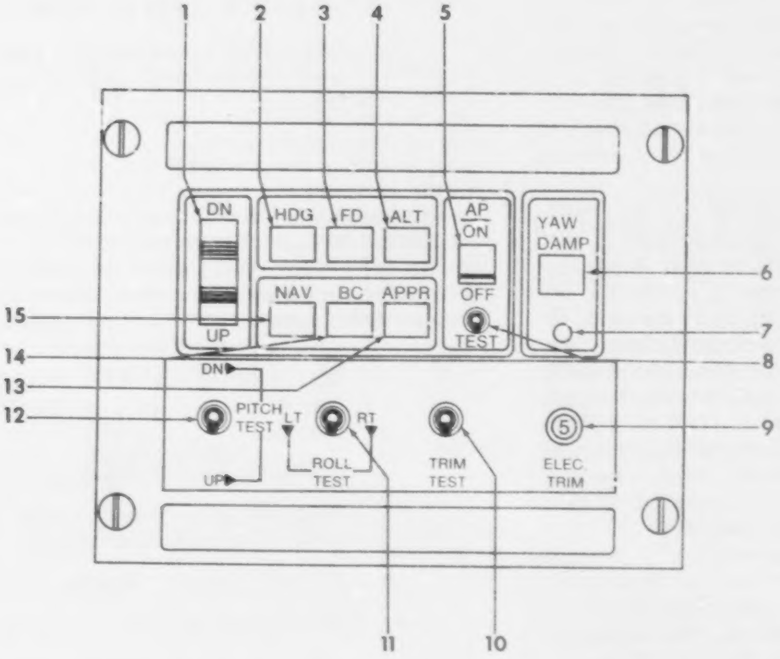
e. Shutdown Procedures.

1. OFF VOL Switch - Turn counterclockwise to off (detent).
2. AVIONICS MASTER Switch - OFF.

3-27. Flight Control System (KFC 250).

a. Description. The flight control system is functionally divided into four parts: sense, compute, display, and control. All sensor information (pitch and roll reference, slaved compass, RNAV/VOR/LOC/GS, DME, marker receiver, and air data) is fed into a flight computer. The flight computer computes pitch and roll commands. These commands are routed to the pilot's flight director indicator (fig. 3-10), where they are displayed on the command V-bar as visual steering commands. These steering commands are also fed to the autopilot computation circuits contained in the flight computer, where the steering commands and aircraft yaw rate information are combined to generate the aileron, elevator trim, and rudder drive commands for the autopilot.

Each servo used in the system incorporates a clutch, which allows for manually overriding the controls. During the autopilot preflight check, all clutches in the system are slipped to assure the pilot can overpower the autopilot at all times. The system is protected by a 10-ampere circuit breaker placarded AP/FD, and a 1-ampere circuit breaker placarded YAW, both located on the copilot's circuit breaker panel (fig. 2-18).



1. Vertical trim switch
2. Heading (HDG) butto
3. Flight director (FD) butt
4. Altitude (ALT) button
5. Autopilot switch
6. Yaw damp switch
7. Yaw damp annunciator
8. Autopilot test switch
9. ELEC TRIM circuit brea
10. TRIM TEST switch
11. ROLL TEST switch
12. PITCH TEST switch
13. Approach (APPR) butto
14. Back course (BC) butto
15. Navigation (NAV) butto

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Figure 3-17. Mode Controller

b. Modes of Operation.

(1) Flight director (FD). The flight director mode is activated by depressing the FD button on the mode controller (fig. 3-17). FLT DIR will display in the mode annunciator panel located on the pilot's instrument panel (fig. 2-22). The FDI command V-bar will appear, providing the pilot with steering commands, to maintain wings level and pitch attitude that existed at the time of flight director engagement. If pitch or roll attitudes are changed, recycling the FD button will synchronize the command V-bar to the new position.

If a change in the commanded pitch attitude is desired, the control wheel steering (CWS) button, installed on both (pilot and copilot) control wheels, allows the pilot or copilot to manually synchronize the command V-bar. The vertical trim switch on the mode controller may also be used to adjust the selected pitch attitude up or down at approximately 1-degree/per second.

NOTE

The flight director (FD) mode must be activated before the autopilot can be engaged.

(2) Autopilot engagement.

CAUTION

Prior to autopilot engagement, insure that command V-bar commands are satisfied.

The autopilot is engaged by moving the AP switch on the mode controller to the ON position. FLT DIR, AUTOPILOT will display in the mode annunciator panel (fig. 2-22). With autopilot selected, yaw damp (YD) mode is automatically engaged.

The autopilot, together with the yaw damp, provides three-axis stabilization, automatic turn coordination, and automatic elevator trim, as well as automatic response to all selected flight director commands.

CAUTION

When the autopilot is engaged, manual application of a force to the pitch axis of the control wheel for a period of 3 seconds or more will result in the autotrim system operating in the direction to create an opposing force. If the autopilot is disengaged under these conditions, the pilot may be required to exert control forces in excess of 50 pounds to maintain the desired aircraft attitude. This force will have to be maintained until the aircraft is manually retrimmed.

(3) Heading select/preselect mode (HDG SEL). Prior to selecting the HDG SEL mode, position the heading bug on the pilot's HSI. Depress the HDG button on the mode controller, activating the HDG SEL mode. HDG SEL will display on the mode annunciator panel (fig. 2-22) and a computed, visually displayed bank command will show on the FDI. The command V-bar on the FDI will deflect in the direction of the shortest turn to satisfy the commanded turn to the preselected heading. The aircraft may be manually banked to realign the command V-bar and satisfy the command or, if the autopilot is engaged, the aircraft will automatically bank, turn to, roll out, and hold the preselected heading. As the aircraft approaches the selected heading, the command V-bar will command a rollout to wings level.

With the HDG SEL mode in operation, subsequent changes made in the heading bug position will immediately cause the command V-bar to call for a turn to the new heading.

The HDL SEL mode is cancelled when NAV or APPR coupling occurs, or whenever the FD or HDG mode buttons are depressed.

CAUTION

An invalid heading source (compass flag in view) will automatically disengage the autopilot. The autopilot may be re-engaged; however, only the vertical modes will be useable.

(4) Yaw damp (YD) mode. The yaw damp controller is located beside the mode controller (fig. 3-17). Yaw axis is automatically engaged when the autopilot is engaged. Disengagment of YD is accomplished by using the alternate action switch located on the yaw damp controller. YD may be engaged alone or with any flight director mode. Yaw damp engage status is indicated by a annunciator, placarded ON, located on the YD controller.

(5) Navigation (NAV ARM and NAV CPLD) mode. The NAV mode provides visual commands on the FDI, and deviation guidance on the pilot's HSI to intercept and track a VOR or RNAV course.

When the NAV button on the mode controller is depressed, NAV/ARM will be displayed on the mode annunciator panel and the automatic capture circuit is armed. HDG SEL is retained until capture occurs. The VOR/RNAV course-capture point is variable to prevent an overshoot. It depends on the angle of intercept and rate that course deviation is changing. Upon capture, a bank command will be displayed on the FDI; HDG (if on) will be cancelled and NAV/CPLD will be displayed on the mode annunciator panel. The pilot can manually bank the aircraft to satisfy the command display which will call for a rollout to level flight when on course centerline to track the course. Crosswind compensation is provided in the track state.

If the NAV mode is selected with the aircraft level 4-degrees of bank and within three dots of course deviation, NAV/ARM will be bypassed and NAV/CPLD will engage directly. If the autopilot is engaged, the aircraft will bank to satisfy the command display and rollout on course automatically.

Upon station (or waypoint) passage, an outbound course other than the inbound reciprocal can be selected by resetting the NAV course arrow on the HSI. This will cause an immediate command V-bar deflection on the FDI directing a turn to the new course.

The NAV mode is cancelled by depressing the NAV button, by selecting HDG (when in NAV coupled) or APPR modes, or deselecting FD.

CAUTION

The NAV mode of operation will continue to provide aircraft control without a valid VOR/LOC signal (NAV flag in view).

(6) Aproach (APPR/ARM, APPR/CPLD and GS CPLD) mode. The APPR mode provides visual roll and pitch commands on the FDI command V-bar to capture and track precision ILS beams, or non-precision VOR radials. Lateral and vertical deviation is monitored on the pilot's HSI.

The automatic APPR capture function will be immediately armed. APPR/ARM will be displayed on the mode annunciator panel. In APPR/ARM mode, prior to capture, the heading select mode is retained.

The LOC beam or VOR capture point will vary, depending on angle of intercept and rate of change of deviation indication. Upon capture, a bank command will be introduced on the FDI, the existing heading mode will be cancelled and APPR/CPLD will be displayed on the mode annunciator panel. The pilot may manually bank the aircraft to satisfy the command display, which will command a rollout to level flight when the aircraft is on course. Automatic crosswind compensation will provide precise tracking. VOR/LOC deviation is shown on the pilot's HSI. Actual crab angle will be indicated by offset of the course arrow from the lubber line.

If the autopilot is engaged during operation in the APPR mode, automatic steering response will follow the command display on the FDI.

The glideslope mode is armed for automatic capture if LOC front course capture has occurred. Automatic glideslope capture occurs as the aircraft passes through the glide path from above or below. Upon interception of the glideslope, capture occurs and GS CPLD is displayed on the mode annunciator panel. A capture pitch command is displayed by the command V-bar. The pilot or autopilot (if engaged) controls the aircraft to satisfy the command V-bar. Upon GS capture, the ALT HOLD mode (if active) is cancelled. However, ALT HOLD may be manually reselected to maintain altitude upon reaching MDA if visual contact is not established.

APPR/CPLD mode is cancelled by selection of HDG, NAV, or go-around modes or by deselecting FD or APPR.

CAUTION

The APPR mode of operation will continue to provide aircraft control without a valid VOR/LOC signal (NAV flag in view).

(7) Back course (BACK CRS) mode. Whenever a LOC or ILS frequency is selected, the BC mode may be activated by depressing the BC button on the mode controller, after selecting APPR. When in BC mode and localizer capture occurs, the system will turn and track outbound on the front course or inbound on the back course. The BC mode reverses the LOC deviation signal and course datum to permit the FDI steering command display to operate on a steer-to rather than a steer-from basis on the reverse course. BACK CRS will be displayed on the mode annunciator panel.

(8) Go-around mode. The go-around mode is primarily designed to assist in establishing the proper pitch attitude under missed approach conditions. However, it can also be used to establish a proper climb attitude during takeoff. The go-around switch is located on the left power lever. Depression of the go-around switch cancels all flight director modes and, if the autopilot is engaged, disengages the autopilot. A wings-level and 8-degree pitch-up command is displayed by the FDI. GO AROUND will be displayed on the mode annunciator panel.

Go-around is cancelled by use of vertical trim, altitude hold mode, control wheel steering or by turning off the flight director.

(9) Altitude select (ALT ARM) mode. This mode allows for selection of an altitude, and upon approaching that altitude obtain an automatic visual pitch command on the FDI, to capture and hold this pre-selected altitude. As the aircraft reaches the selected altitude, ALT HOLD will automatically engage, ALT HOLD will display on the mode annunciator panel and ALT ARM display will disappear. If the autopilot is engaged the system will automatically capture and hold the selected altitude.

ALT ARM is disengaged by depressing the ALT ARM button, by engaging ALT HOLD, by GS capture, or deselecting FD.

(10) Altitude hold (ALT HOLD) mode. This mode will cause a computed visual pitch command on the FDI command bars to hold the aircraft at the pressure altitude existing at the time the mode was activated. The mode is activated either automatically by the ALT ARM function, or manually by depressing the ALT button on the mode controller. If the autopilot is engaged, it will automatically hold the aircraft at that altitude.

The vertical trim switch is used to adjust the selected altitude up or down at a constant rate of approximately 600 fpm without disengaging the mode.

The ALT HOLD mode is cancelled by automatic Glideslope capture, selection of ALT ARM/GO-AROUND modes, or deselecting FD.

(11) Control wheel steering (CWS). When the autopilot is engaged, CWS provides the pilot with the capability for manual maneuvering of the aircraft without the need to disengage and reengage the autopilot, or reselect any modes of operation. CWS is engaged by continuous pressure on the CWS button, located on either the pilot's or copilot's control wheel. Operation of the CWS button causes immediate release of autopilot servos allowing the pilot to assume manual control. Upon release of the CWS button, the autopilot will reassume control of

the aircraft to the original lateral, and existing vertical commands.

Since all engaged modes remain coupled during operation of the CWS switch, their annunciator displays will continue to show on the mode annunciator panel.

c. Operating Procedures.

WARNING

Insure that the autopilot has been disengaged and check that the aircraft manual trim indicator is set to the takeoff position before takeoff. Operating the autopilot on the ground may cause the autotrim to run because of back force generated by the elevator downsprings or pilot induced forces.

WARNING

If the AUTOPILOT circuit breaker is pulled, the red TRIM failure annunciator light on the autopilot annunciator panel will be disabled and only the aural alert will sound if an electric trim malfunction occurs. If the aural alert sounds pull the ELECT TRIM circuit breaker and accomplish inflight trimming with the manual trim wheel.

1. AVIONICS MASTER Switch - ON.
2. Flight Director Switch - Press on.

CAUTION

Prior to autopilot engagement insure that command V-bar commands are satisfied.

3. Autopilot Switch (AP) - ON.
4. Autopilot Modes - As required.

d. Shutdown Procedures.

1. Flight Director Switch - Disengage.
2. AVIONICS MASTER Switch - OFF

SECTION IV. TRANSPONDER AND RADAR

3-28. Transponder (KT 76A).

a. Description. The transponder (fig. 3-18) is an identification, position tracking, altitude reporting, and emergency tracking device. The unit receives, decodes, and responds to interrogations by search radar. The range of the set is normally limited to line-of-sight. The transponder is protected by a 3-ampere circuit breaker, placarded XPDR 1, located on the right subpanel. The associated antenna is shown in figure 2-1.

b. Controls and Functions.

(1) Function selector switch. Provides for selection of OFF, SBY, ON, ALT, and TST postions.

(a.) OFF position. Removes power from the unit.

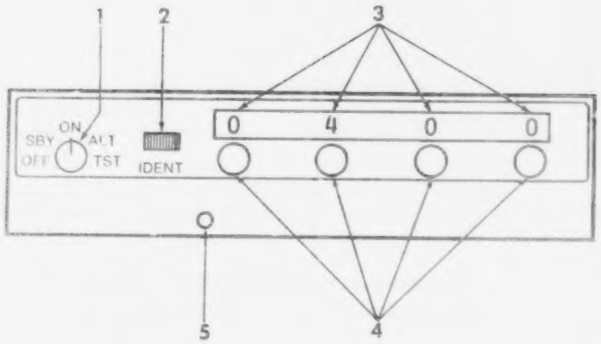
(b.) SBY position. The unit should be placed in SBY after engine start for warm up. It takes approximately 47 seconds for the transponder to warm up and become operational.

(c.) ON position. When the transponder is in the ON position the unit is operating in mode A. Mode A provides for normal operation without altitude reporting.

(d.) ALT position. When the transponder is in the ALT position the unit is operating in mode C (altitude reporting). Mode C provides for normal operation along with altitude reporting. The aircraft altitude is automatically reported to the ground controller in increments of 100 feet from minus 1000 feet up to 63,000 feet.

(e.) TST position. When the function selector switch is held in the TST position the reply annunciator should illuminate and remain illuminated until the selector switch is placed in another position. This provides for a integral test of the unit.

(2) Reply annunciator. During normal transponder operation, a flashing annunciator is an indication of a transmitted reply. An interrogation will normally be at 10-15 second intervals. Flashes within this interval may be from noise, a second or third interrogator, or from side lobes (from interrogators without side lobe suppression). When the IDENT button is depressed the reply annunciator will glow steady as an indication of the ident function.



1. Function selector switch
2. Reply annunciator
3. Code windows
4. Control knobs
5. Ident button

Figure 3-18. Transponder (KT 76A)

(3) *Code windows.* Displays transponder reply codes as selected with the control knobs.

(4) *Control knobs.* The control knobs are used to select the desired transponder reply codes. Attention should be paid to the code selected. The selected code should be in accordance with instructions for IFR flight or rules applicable to transponder utilization for VFR flight. Unless required, avoid selecting 7700, 7600, or 7500 codes. These codes are for emergencies, loss of communications, and hijacking respectively.

(5) *IDENT button.* The IDENT button feature is used at the request of the traffic controller. The IDENT button is depressed momentarily and then released. A memory holds the IDENT reply for an interval to assure the proper reply for at least one radar sweep. This memory also turns the reply lamp on steady as an indication of the ident function.

c. Operating Procedures.

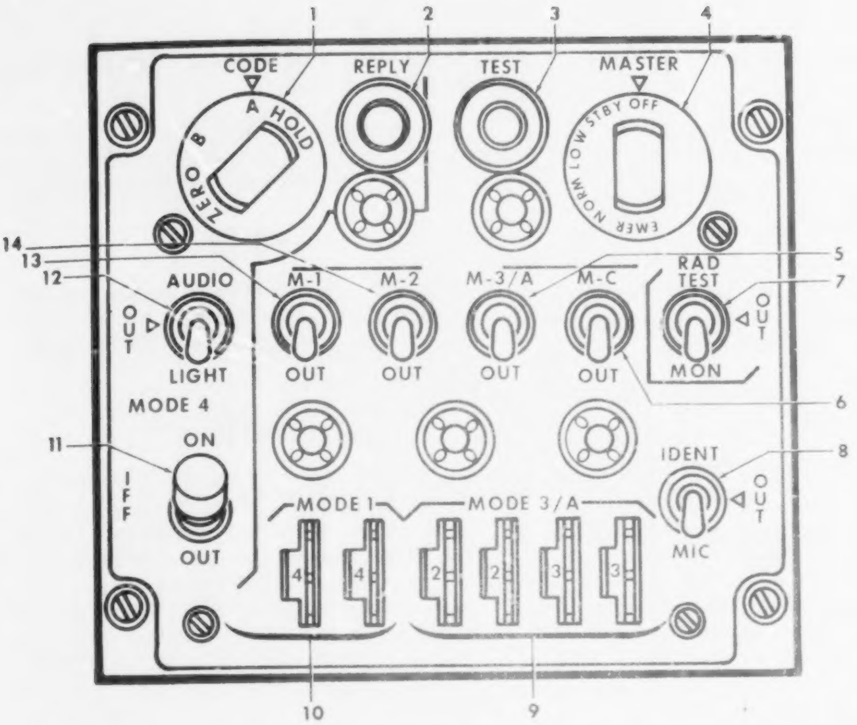
1. AVIONICS MASTER Switch - ON.
2. Transponder Reply Code - Set as required.
3. Function Selector Switch - SBY (allow time for warm up).
4. Function Selector Switch - ON or ALT prior to takeoff.
5. Ident Button - Depress as required.

d. Shutdown Procedure.

1. Function Selector Switch- OFF.
2. AVIONICS MASTER Switch -OFF.

3-29. Transponder Set (AN/APX-72) (If installed).

a. Description. The transponder set (fig. 3-19) is an identification, position tracking, and emergency tracking device. This set receives, decodes, and responds to interrogations by search radar. It operates in conjunction with a TS-1843/APX inflight test set which provides a self test feature, and a KIT-1A/TSEC computer which provides mode 4 feature. Power for the system is fed through two 50-ampere circuit breakers, placarded AVIONICS 1 and AVIONICS 2, located on the copilot's circuit breaker panel. The system is protected by a 10-ampere circuit breaker, placarded XPDR 2, located on the right subpanel.


1
2
3
4
CODE
REPLY
TEST
MASTER
A
HOLD
B
ZERO
STBY
OFF
LOW
NORM
EMER
14
13
12
5
7
AUDIO
M-1
M-2
M-3/A
M-C
RAD TEST
OUT
LIGHT
OUT
OUT
OUT
OUT
MON
OUT
MODE 4
6
ON
IDENT
8
11
IFF
MODE 1
MODE 3/A
OUT
MIC
OUT
4
4
2
2
3
3
10
9
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1. CODE control
2. REPLY light
3. TEST light
4. MASTER control
5. M 3/A switch
6. M-C switch
7. RAD TEST-MON switch
8. IDENT-MIC switch
9. MODE 3/A code selectors
10. MODE 1 code selectors
11. MODE 4 ON-OUT lights
12. MODE 4 AUDIO-LIGHT switch
13. M-1 switch
14. M-2 switch

Figure 3-19. Transponder Control Panel (AN/APX-72)

b. Controls and Functions.

(1) CODE control. Selects mode 4 code of the day, A or B.

(a.) HOLD position. Prevents zeroizing when power is removed from the set or MASTER control is turned OFF.

(b.) A position. Selects keyed in code A.

(c.) B position. Selects keyed in code B.

(2) REPLY light. Indicates valid mode 4 interrogations and replies when MODE 4 AUDIO LIGHT switch is in AUDIO or LIGHT positions.

(3) TEST light. Indicates the proper response has been generated when the M-1, M-2, M-3/A, and M-C switches are placed in TEST position. Also illuminates when RAD TEST-MON switch is in MON position and replies are made to M-1, M-2, or M-3/A interrogations.

(4) MASTER control. Provides a means of selecting the following:

(a.) OFF position. Turns set off.

(b.) STBY position. Places set in warm-up (standby) condition.

(c.) LOW position. Places set at low sensitivity.

(d.) NORM position. Operates set at normal sensitivity.

(e.) EMER position. Transmits emergency reply.

(5) M-1, M-2, M-3/A and M-C switches. Provides a means of selecting the following:

(a.) Up (on) position. Permits set to reply in the selected mode.

(b.) OUT position. Disables replies.

(c.) TEST position. Permits self test in the selected mode when test set TS-1843A/APX is installed. The transponder set can also reply to ground interrogations in the selected mode while being tested.

(d.) M-1 and M-2 switches. Response to military identification interrogations.

(e.) M-3/A switch. Response to civilian identification interrogations.

(f.) M-C switch. Response to altitude reporting interrogations.

(6) RAD TEST MON switch. Provides a means of selecting the following:

(a.) RAD TEST. Enables an appropriately equipped transponder to reply to TEST mode interrogations.

(b.) MON position. Turns on circuits in the transponder test set to monitor for proper replies to M-1, M-2 or M-3/A interrogations.

(7) IDENT MIC switch. Provides a means of selecting the following:

(a.) IDENT position. Activates identification feature.

(b.) MIC position. Inoperative in this installation.

(8) MODE 1 and MODE 3/A code selectors. Selects the desired reply codes for modes 1 and 3A.

NOTE

Mode 2 code selector is located on the transponder receiver-transmitter and should be set prior to flight when required.

(9) MODE 4 IFF ON OUT switch. Provides a means of selecting the following:

(a.) ON position. Permits transponder set to decode a mode 4 interrogation.

(b.) OUT position. Disables mode 4 decoding.

(10) AUDIO OUT LIGHT switch. Provides a means of selecting the following:

(a.) AUDIO position. Permits aural and reply light monitoring of valid mode 4 interrogations and replies.

(b.) OUT position. Disables mode 4 decoding.

(c.) LIGHT position. Permits only REPLY light monitoring.

c. IFF Caution Light. The function of the IFF caution light (fig. 2-22), placarded IFF CAUTION, is as follows:

(1) IFF. Indicates that the transponder set has failed to reply to a valid mode 4 interrogation. It also illuminates when mode 4 codes have been zeroized.

d. Transponder Set Operation. If mode 4 operation is required, perform the following procedures after the landing gear has been retracted.

NOTE

MODE 2 code selectors are located on the transponder receiver-transmitter and should be set prior to flight when required.

NOTE

To prevent zeroizing the mode 4 function of the transponder, when the landing gear is down and the struts compressed, place the CODE control momentarily in HOLD position before either transponder or aircraft power is turned off. CODE HOLD condition will only be removed when the struts are extended and the MASTER control is not in OFF position.

1. MASTER control - STBY (allow 2 minute warmup). Modes 1, 2, 3/A, and/or mode 4 operating procedure.
2. MASTER CONTROL - LOW or NORM. Set for required receiver sensitivity.
3. M-1, M-2, M-3/A, and/or MODE 4 ON OUT switches - ON. Actuate only those switches corresponding to the required codes. The remaining switches should be left in the OUT position.
4. MODE 1 code selectors - Set (if applicable).
5. MODE 3/A code selectors - Set (if applicable).
6. CODE control - Set (as required).
7. RAD TEST MON switch - MON (if desired).
8. TEST light - Monitor to determine when transponder set is replying to a IFF interrogation.
9. MODE 4 AUDIO LIGHT switch - Set (as required to monitor mode 4 interrogations and replies).
10. AUDIO and/or observe REPLY light - Listen and/or observe (mode 4 interrogations and replies.

11. IFF CAUTION light (instrument panel fig. 2-22) - Monitor for an indication (light will illuminate if transponder fails to reply to a mode 4 interrogation or when the mode 4 codes have been zeroized).

NOTE

If IFF CAUTION light illuminates, check the position of the MODE 4 ON OUT switch immediately. If the switch is in the ON position, establish contact with the interrogating station on a communications set and explain the situation.

(1) To Test Transponder Set Operation in Modes 1, 2, C and/or 3/A.

NOTE

The following self-tests will not prevent transponder set replies to external interrogations. Test only those modes that are being used.

1. M-1, M-2, M-3/A, M-C switches - Momentarily set switches to test position, one at a time.
2. TEST light - Observe for indication as each code switch is held in TEST position. If TEST light fails to light, recheck applicable control settings. If the light does not illuminate after the control settings have been rechecked, either the transponder or the self-test feature is faulty.

(2) Transponder Set Identification Position Operating Procedure.

NOTE

The transponder set can make identification-position replies while operating in code modes 1, 2, and/or 3/A in response to ground station interrogations. This type of operation is initiated by the operator as follows.

1. Modes 1, 2, and/or 3/A - Operating.
2. IDENT MIC switch - Press momentarily to IDENT, when directed.

NOTE

Holding circuits within the transponder receiver-transmitter will transmit identification-position signals for approximately 30 seconds. This is normally sufficient time for ground control to identify the aircraft's position. During this 30 second period, it is normal procedure to acknowledge via the aircraft communications set, that identification-position signals are being generated.

(3) Shutdown Procedure.

NOTE

To prevent zeroizing the MODE 4 function of the transponder, when the landing gear is down and the struts compressed, place the CODE control momentarily in HOLD position before either transponder or aircraft power is turned off. CODE HOLD condition will only be removed when the struts are extended and the MASTER control is not in OFF position.

1. CODE control - HOLD (when required to hold MODE 4 code).
2. MASTER control - OFF.

e. Emergency Operation.

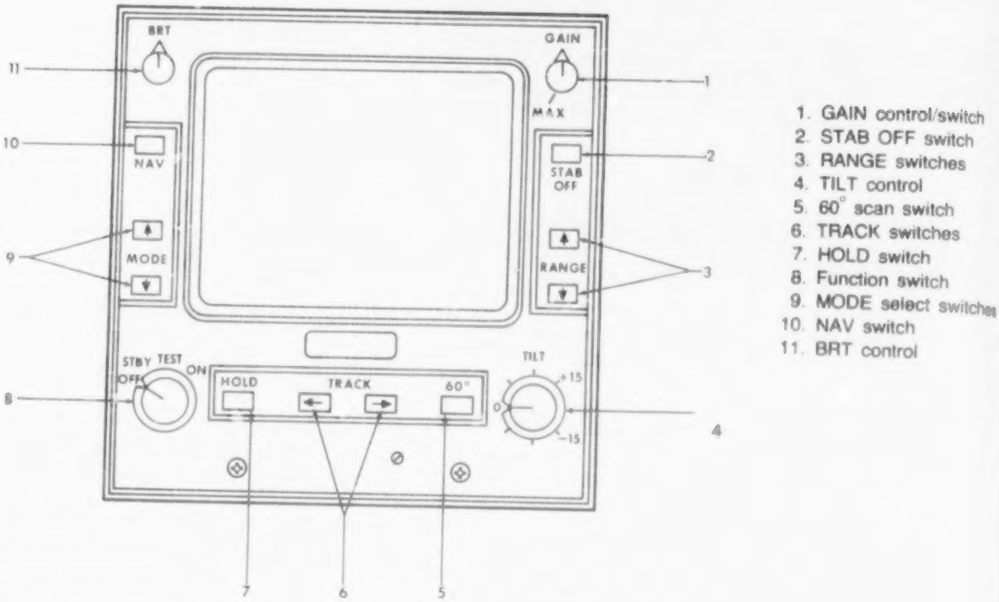
NOTE

The MASTER switch on the transponder control panel shall be placed in the EMER position only under emergency conditions.

1. Modes 1, 2, and/or 3/A - Operating.
2. Master switch - EMER.

3-30. Weather Radar Set (AN/APN-215(V).

a. Description. The weather radar set (fig. 3-20) provides a visual presentation of the general sky area of approximately 120 degrees around the nose of the aircraft, extending to a distance of 240 nautical miles. The presentation on the screen shows the location of potentially dangerous areas, such as thunderstorms and hailstorms, in terms of distance and azimuth with respect to the aircraft. The radar is capable of ground mapping operations. Radar antenna stabilization signals are supplied by the vertical gyro. The antenna is a flat-plate, nose mounted unit (fig. 2-1). Protection is provided by a 5-ampere



1. GAIN control/switch
2. STAB OFF switch
3. RANGE switches
4. TILT control
5. 60° scan switch
6. TRACK switches
7. HOLD switch
8. Function switch
9. MODE select switches
10. NAV switch
11. BRT control

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Figure 3-20. Weather Radar Control/Indicator (AN/APN-215(V)

circuit breaker, placarded RADAR, located on the right subpanel (fig. 2-7).

b. Controls and Functions.

(1) GAIN control. Used to adjust radar receiver gain in the MAP mode only.

(2) STAB OFF switch. Push on/push off type switch. Used to control antenna stabilization signals.

(3) RANGE switches. Momentary action type switches. When pressed, clears the screen and increases or decreases the range depending on switch pressed.

(4) TILT control. Varies the elevation angle of radar antenna 15 degrees up or down from horizontal attitude of aircraft.

(5) 60° switch. Push on/push off type switch. When activated, reduces antenna scan from 120 degrees to 60 degrees.

(6) TRACK switches. Momentary action type switches. When activated, a yellow track line extended from the apex of the display through top range mark appears and moves either left or right, depending on the switch pressed. The track line position will be displayed in degrees in the upper left corner of the screen. The line will disappear approximately 15 seconds after the switch is released. It will then automatically return to 0 degrees.

(7) HOLD switch. Push on/push off type switch. When activated, the last image presented before pressing the switch is displayed and held. The word HOLD will flash on and off in the upper left corner of the screen. Pressing the switch again will update the display and resume normal scan operation.

(8) Function switch. Controls operation of the radar set.

(a.) OFF. Turns set off.

(b.) STBY. Places set in standby mode. This position also indicates a 90 second warmup delay when first turned on.

(c.) TEST. Displays test pattern to check for proper operation of the set. The transmitter is disabled during this mode.

(d.) ON. Places set in normal operation.

(9) MODE switches. Momentary action type switches. Pressing and holding either switch

will display an information list of operational data on [illegible] screen. The data heading will be in blue, all data except present data will be in yellow and present selected data will show in blue. The three weather levels will be displayed in red, yellow and green. If WXA mode has been selected, the red bar will flash on and off. If the switch is released and immediately pressed again, the mode will increase or decrease depending on switch pressed. When either tor of bottom mode is reached, the opposite switch must be pressed to further change the mode.

(10) NAV switch. The words NO NAV will be displayed in the lower left corner unless the indicator is supplied with navigation data from other avionics not covered by this manual.

(11) BRT control. Used to adjust screen brightness.

c. Operating Procedures

WARNING

Do not operate the weather radar set while personnel or combustible materials are within 18 feet of the antenna flat-plate array. When the weather radar set is operating, high-power radio-frequency energy is emitted from the antenna flat-plate array, which can have harmful effects on the human body, and can ignite combustible materials.

CAUTION

Do not operate the weather radar set in a confined space where the nearest metal wall is 50 feet or less from the antenna flat-plate array. Scanning such surfaces may damage receiver crystals.

(1) Turn on Procedure.

1. Avionics MASTER switch - ON.
2. Function switch - TEST or ON as required (information will appear after time delay period has elapsed).

(2) Initial Adjustments Operating Procedure.

1. BRT control - As required.
2. MODE switches - Press and release as required.
3. RANGE switches - Press and release as required.
4. TILT control - Move up or down to observe targets above or below aircraft level. The echo display will change in shape and location only.

(3) Test Procedure.

1. Function switch - TEST.
2. RANGE switches - Press and release as required to obtain 80 mile display.
3. BRT control - As required.
4. Screen - Observe for proper display. The test display consists of two green, two yellow, and a red band on a 120 degree scan. The word TEST will be displayed in the upper right corner. The operating mode selected by the MODE switches, either MAP, WX or WXA, will be displayed in the lower left corner. If WXA has been selected, the red band in the test pattern will flash on and off. The range will be displayed in the upper right corner beneath the word TEST and appropriate range mark distances will appear along the right edge of the screen.

(4) Weather Observation Operating Procedure.

1. Function switch - ON.
2. MODE switches - Press and release as required to select WX.
3. BRT control - As required.
4. TILT control - Adjust until weather pattern is displayed. Include the areas above and below the rainfall areas to obtain a complete display.
5. MODE switches - Press and release to select WXA. Areas of intense rainfall will appear as flashing red.
6. TRACK switches - Press to move track line through area of least weather intensity. Read relative position, in degrees, in upper left corner of screen.

NOTE

Refer to TM 11-5841-28-9-13 for both weather and ground mapping functions of Radar Set AN/APN-215(V).

(5) Ground Mapping Operating Procedure.

1. Function switch - ON
2. MODE switches - Press and release as required to select MAP.
3. BRT control - As required.
4. GAIN control - As required to present usable display.

(6) Standby Procedure.

1. Function switch - STBY.

(2) Shutdown Procedure.

1. Function switch - OFF.
2. Avionics MASTERswitch - OFF.

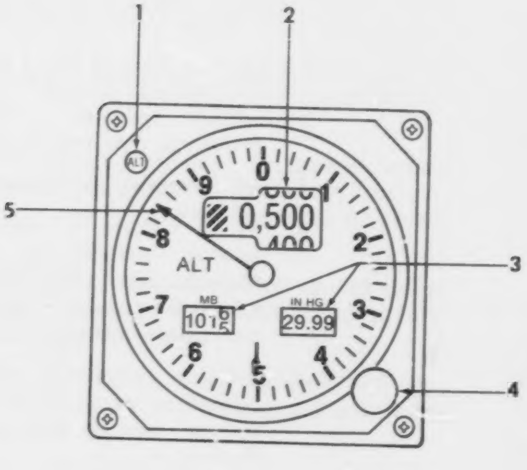
3-31. Pilot's Encoding Altimeter.

a. Description. The encoding altimeter (fig. 3-21) provides the pilot with an indication of the aircraft's altitude above sea level in addition to providing the transponder with altitude information for use in mode C. The encoding altimeter is protected by a 1-ampere circuit breaker, placarded ENC ALT, located on the right subpanel.

b. Controls and Functions.

(1) Altitude alert annunciator. The ALT annunciator will illuminate when the aircraft is between ±300 feet and ±1000 feet of a preselected altitude. When the aircraft is within ±300 feet of the selected altitude the ALT annunciator will extinguish. However, upon reaching the selected altitude, the ALT annunciator will illuminate and stay illuminated for two seconds, then extinguish. Upon deviating ±300 feet from the selected altitude the ALT annunciator will again illuminate and stay illuminated until the aircraft is ±1000 feet from the selected altitude, whereupon it will again extinguish.

(2) Altitude (drum) display. The drum display provides a full five figured digital readout of altitude in increments of 100 feet. Black and white cross-hatching is provided in place of the first digit of the counter to command attention at altitudes below 10,000 feet. Altitudes below sea level are indicated by a wavey blue and white line which takes the place of the first digit of the counter. In the event of power failure or a detection of a malfunction by the



1. Altitude alert (ALT) annunciator
2. Altitude (drum) display
3. Barometric windows
4. Barometric correction knobs
5. Needle indicator

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Figure 3-21. Pilot's Encoding Altimeter

failure monitor, a red and white striped warning flag obscures the numbers on the digital counter.

(3) Barometric windows. Dual baroscales, which permit barometric pressure settings in both millibars and inches of mercury, display in the barometric windows. These settings are inputted with the barometric correction knob, which simultaneously sets millibars (MB) and inches (HG) of mercury.

(4) Barometric correction knob. The barometric correction knob is used to set the desired atlimeter setting in the display windows. The knob simultaneously sets the millibars and inches of mercury.

(5) Needle indicator. The needle indicates aircraft altitude in hundreds of feet with subdivisions at twenty-foot intervals. One revolution of the needle equals 1000 foot of altitude change.

c. Operating Procedure.

1. Barometric Correction Knob - Set desired altimeter setting in barometric window. Note that needle indicator operates properly.
2. Warning Flag - Check not visible.

NOTE

If the altimeter does not read within 70 feet of field elevation when the correct local barometric setting is used, the altimeter needs calibration or internal failure has occurred. An error of greater than 70 feet nullifies use of the altimeter for IFR flight.

CHAPTER 4

MISSION EQUIPMENT

This aircraft is not equipped with mission equipment.

CHAPTER 5

OPERATING LIMITS AND RESTRICTIONS

SECTION I. GENERAL

5-1. Purpose.

This chapter identifies or refers to all important operating limits and restrictions that shall be observed during ground and flight operations.

5-2. General.

The operating limitations set forth in this chapter are the direct result of design analysis, tests, and operating experiences. Compliance with these limits will allow the pilot to safely perform the assigned missions and to derive maximum utility from the aircraft.

5-3. Exceeding Operational Limits.

Anytime an operational limit is exceeded an appropriate entry shall be made on DA Form 2408-13. Entry shall state what limit or limits were exceeded, range, time beyond limits, and any additional data that would aid maintenance personnel in the maintenance action that may be required.

5-4. Minimum Crew Requirements.

The minimum crew required for aircraft operation is one pilot. Additional crewmembers as required will be added at the discretion of the commander, in accordance with pertinent Department of the Army regulations.

SECTION II. SYSTEM LIMITS

5-5. Instrument Markings.

Several instruments display operating limitations (fig. 5-1). The operating limitations are color coded on the instrument faces. Color coding of each instrument is explained in the illustration. The instrument illustration also denotes, in bolt type, the fuel grade upon which limits are based.

5-6. Instrument Marking Color Codes.

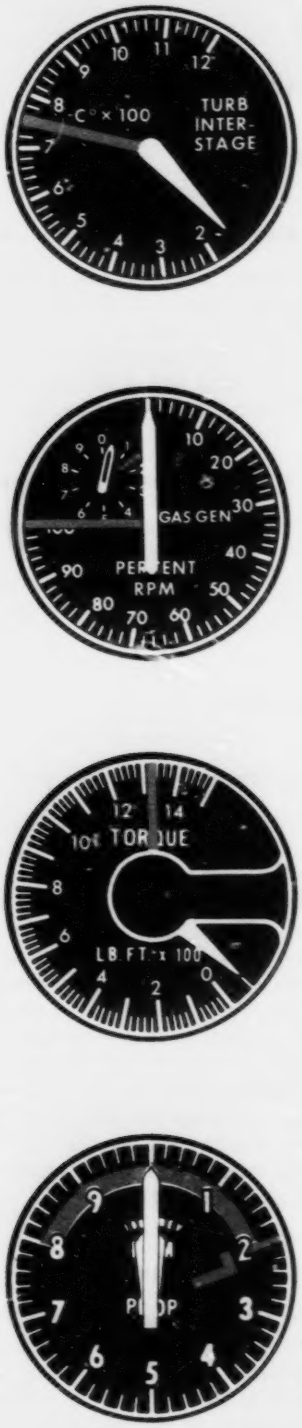
Operating limitations and ranges are illustrated by the colored markings which appear on the dial faces of engine, flight, and utility system instruments. RED markings on the dial faces of these instruments indicate the limit above or below which continued operation is likely to cause damage or shorten life. The GREEN markings on instruments indicate the safe or normal range of operation. The YELLOW markings on instruments indicate the range when special attention should be given to the operation covered by the instrument. Operation is permissible in the yellow range, but should be avoided. WHITE markings on the instruments indicate flap operating range.

5-7. Instrument Glass Alignment Marks.

Limitation markings consist of strips of semitransparent color tape which adhere to the glass outside of an indicator dial. Each tape strip shall align to increment makers on the dial face so correct operating limits are portrayed. The pilot should occasionally verify alignment of the glass to the dial face. For this purpose, all engine instruments (except fuel flow meters) have short, vertical white alignment marks extending from the bottom part of the dial glass onto the fixed base of the indicator. These slippage marks appear as a single vertical line when limitation markings on the glass properly align with reading increments on the dial face. However, the slippage marks appear as separate radial lines when a dial glass has rotated..

5-8. Propeller Limitations.

Propeller limitations consist of RPM limits and situation limits for the use of reverse pitch. The normal propeller operating range (green arc) extends from 1800 to 2200 RPM, with a red line at 2200 RPM. However, the actual governor controlled limits are 1750 to 2332 RPM. The lower limit of 1725 to 1775 RPM is controlled by the primary governor.


9
10
11
12
8
C° x 100
TURB
INTER-
STAGE
7
6
5
4
3
2
10
20
30
40
50
60
70
80
90
100
GAS GEN
PERCENT
RPM
12
14
10
TORQUE
8
6
LB. FT. x 100
4
2
0
9
1
8
2
7
PROP
3
6
5
4

INTERSTAGE TURBINE TEMPERATURE

▬ 750 C MAXIMUM

TURBINE TACHOMETER (N1 SPEED)

▬ 101.5% MAXIMUM

TORQUE

▬ 1315 FT LB MAXIMUM

PROPELLER TACHOMETER

▬ 1800-2200 RPM NORMAL OPERATING RANGE

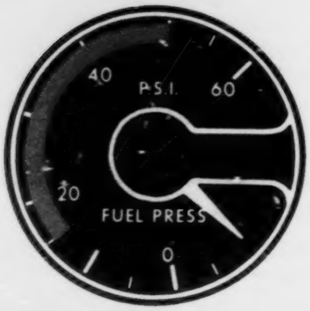
▬ 2200 RPM MAXIMUM

R ▬
G ▬

AP001548

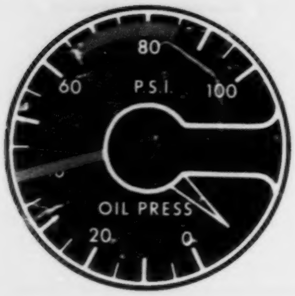
Figure 5-1. Instrument Markings (Sheet 1 of 3)

FUEL GRADE JP-4


40
P.S.I.
60
20
FUEL PRESS
0

FUEL PRESSURE

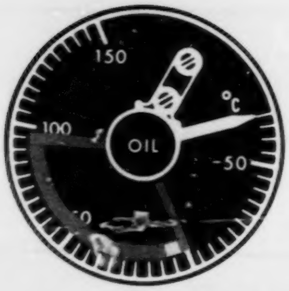
🟩 15-50 PSI NORMAL OPERATING RANGE


80
60
P.S.I.
100
OIL PRESS
20
0

OIL PRESSURE

🟥 40 PSI MINIMUM

🟩 65-85 PSI NORMAL OPERATING RANGE


150
°C
100
OIL
-50

OIL TEMPERATURE

🟥 0 C MINIMUM

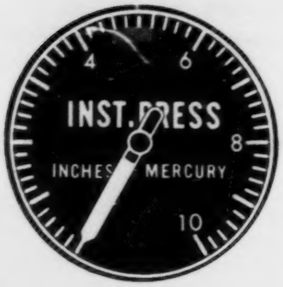
99 C MAXIMUM USING ENGINE
OIL SPEC MIL-L-23699

* 85 C MAXIMUM USING ENGINE
OIL SPEC MIL-L-7808

☐ 0-10 C CAUTIONARY

🟩 10-99 C NORMAL OPERATING RANGE USING
ENGINE OIL SPEC MIL-L-23699

* 10-85 C NORMAL OPERATING RANGE USING
ENGINE OIL SPEC MIL-L-7808


4
6
INST. PRESS
8
INCHES MERCURY
10

INSTRUMENT AIR PRESSURE

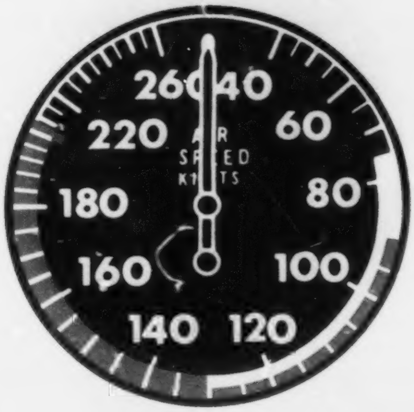
🟩 HG 4.5 - 5.2 NORMAL OPERATING RANGE

* FOR OPERATION BELOW -40 F (-40 C)

R 🟥
G 🟩
☐

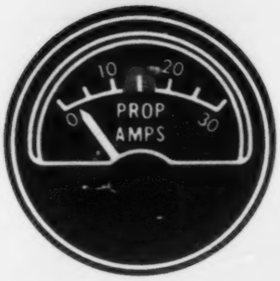
AP001548 2

Figure 5-1. Instrument Markings (Sheet 2 of 3)


260
40
220
60
AIR
SPEED
KNOTS
180
80
160
100
140
120

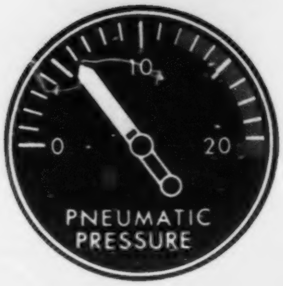
AIRSPEED INDICATOR

- ▭ 75-130 KNOTS (CAS) NORMAL OPERATING RANGE WITH FULL FLAPS
- ■ 92-208 KNOTS (CAS) NORMAL OPERATING RANGE
- ■ 208 KNOTS (CAS) MAXIMUM


10
20
0
PROP
AMPS
30

PROPELLER DEICER AMMETER

- ■ 14-18 AMPERES NORMAL OPERATION


10
0
20
PNEUMATIC
PRESSURE

PNEUMATIC PRESSURE

- ■ 12-20 PSI NORMAL OPERATING RANCE
- ■ 20 PSI MAXIMUM

AP001548.3

Figure 5-1. Instrument Markings (Sheet 3 of 3)

The upper limit of 2332 RPM is maintained by the power turbine governor (should the primary and overspeed governors fail). During reverse pitch operation, the power turbine governor prevents propeller speed from exceeding 2040 RPM. Refer to chapter 2 for propeller governor details.

5-9. Starter Limitations.

The starters in this aircraft are limited to an operating period of 40 seconds on, then 60 seconds off (STOP), for two starter operations. After two starter operations the starter shall be operated for 40 seconds on, then 30 minutes off (STOP).

5-10. Autopilot Limitations.

a. During autopilot operation, one pilot must be seated at the controls with seat belt fastened.

b. Autopilot and yaw damper must be disengaged during takeoff or landing.

c. The system is approved for Category I operation only (approach mode selected).

d. Do not operate autopilot with flaps extended beyond the approach position.

e. Maximum altitude for autopilot operation is 25,000 feet.

SECTION III. POWER LIMITS

5-11. Engine Limitations.

Operation of the T74-CP-700 engines is monitored by instruments with the operating limits marked on the face of the dial. Table 5-1 shows all operating conditions and limits for the engine.

a. Engine operation using only the engine-driven primary (high presssure) fuel pump without auxiliary fuel pump or engine-driven boost pump fuel pressure is limited to 10 accumulative hours. All time in this category shall be entered on DA Form 2408-13 for the attention of maintenance personnel.

b. Use of aviation gasoline is time-limited to 150 hours of operation during any Time-Between-Overhual (TBO) period. It may be used in any quantity with primary of alternate fuel.

NOTE

Aviation gasoline (AVGAS) contains a form of lead which has an accumulative adverse effect of gas turbine engines. The lowest octane AVGAS available (less lead content) should be used. If any AVGAS is used the total operating time must be entered on DA Form 2408-13.

5-12. Overtemperature and Overspeed Limitations.

a. Whenever the limit in temperatures listed in the Engine Operating Limitations Chart are exceeded and cannot be controlled by retarding the power levers the engine shall be shut down or a landing shall be made as soon as possible. It should be noted that maximum observed interstage turbine temperature (ITT) of 850°C is time-limited to two seconds duration when accelerating engine.

b. During engine starting the temperatures and time limits listed in the Engine Operating Limitations Chart shall be observed (Table 5-1). When these limits are exceeded, the incident shall be entered as an engine discrepancy on DA Form 2408-13. It is particularly important to record the amount and duration of overtemperature.

c. Whenever the prescribed engine overspeed limit or engine RPM operating limit is exceeded the incident must be reported as an engine discrepancy on DA Form 2408-13. It is particularly important to record the maximum percent of RPM registered by the tachometer, and the duration of overspeed.

d. Ground operation of inverters, with aircraft engines shut down, is limited to 30 minutes unless the inverter access/cooling doors on the upper wing are removed.

5-13. Power Definitions For Engine Operation.

The following definitions described the engine power ratings listed in the Engine Operating Limitations Chart, Table 5-1.

a. Takeoff Power. The maximum power available from an engine for takeoff, limited to periods of five minutes duration.

b. Maximum Power. The maximum power available from an engine for use during an emergency operation.

c. Normal Rated Climb Power. The maximum power available from an engine for continuous normal climb operations.

d. Normal Rated Power. The maximum power available from an engine for continuous operation in cruise (with lower ITT limit than normal rated climb power).

5-14. Ambient Temperature Takeoff Limitation.

A limitation based on pressure altitude and ambient temperature prohibits aircraft takeoff under certain high ambient temperature conditions. The Takeoff Temperature Limitations Chart determines this limitation (fig. 5-2).

Table 5-1. Engine Operating Limitations

POWER RATING	OPERATING LIMITS							
	MAX TIME	★ TORQUE FT LB	★MAX OBSERVED ITT	① N1%	● N2 RPM (PROP)	OIL PRESS PSIG ②	OIL TEMP °C ③	OIL TEMP °C ④
TAKEOFF ⑤	5 MINUTES	1315	750	101.5	2200	65-85	10-99	10-85
MAXIMUM	CONTINUOUS	1315	750	101.5	2200	65-85	10-99	10-85
NORMAL RATED CLIMB	CONTINUOUS	1315✱	725	—	2200	65-85	0-99	0-85
NORMAL RATED	CONTINUOUS	1315✱	705	—	2200	65-85	0-99	0-85
HIGH IDLE (73% N1)	CONTINUOUS	...	...	...	—	—	0-99	0-85
LOW IDLE (54% N1)	CONTINUOUS	...	685 ⑥	...	—	40 (MIN)	-40-99	-40-85
STARTING	...	...	1090 (2 SEC)	—	—	—	-40 (MIN)	-40 (MIN)
ACCELERATION ⑦	2 SECONDS	1500	850	102.6	—	—	0-99	0-85
MAX REVERSE	1 MINUTE	—	750	88	—	65-85	0-99	0-85
PROP FEATHER	CONTINUOUS	525	—	—	—	—	—	—
	2 SECONDS	1500	—	—	—	—	—	—

GENERATOR LOAD	MINIMUM ENGINE RPM
0 to .5 Load	50%
.5 to .75 Load	57%
.75 to .90 Load	59%
.90 to 1.0 Load	63%

★ Each column is a separate limitation. The stated limits do not necessarily occur simultaneously.

● The limit values within the N2 RPM (PROP) column are not propeller limitations. These values specify propeller RPMs which correspond to stress limits of the engine power section.

✱ This is an engine gearbox torque limit which shall not be exceeded under steady state or continuous engine operation.

① For every 10°C below -30°C ambient temperature, reduce maximum allowable N1 by 2.2%.

② Oil pressure below 65 PSIG is undesirable at power settings above 75% N1. Flight may be completed at a reduced power setting, but the cause of low oil pressure should be corrected prior to next flight. Oil pressure below 40 PSIG requires engine shutdown.

③ 99°C maximum when using engine oil spec. MIL-L-23699.

④ 85°C maximum when using engine oil spec. MIL-L-7808.

⑤ This power rating is intended for emergency use at the discretion of the pilot.

⑥ High ITT may be decreased by reducing accessory load and/or increasing N1 speed.

⑦ High generator loads at low N1 speeds may cause the ITT acceleration temperature limit to be exceeded. Observe the above generator limits.

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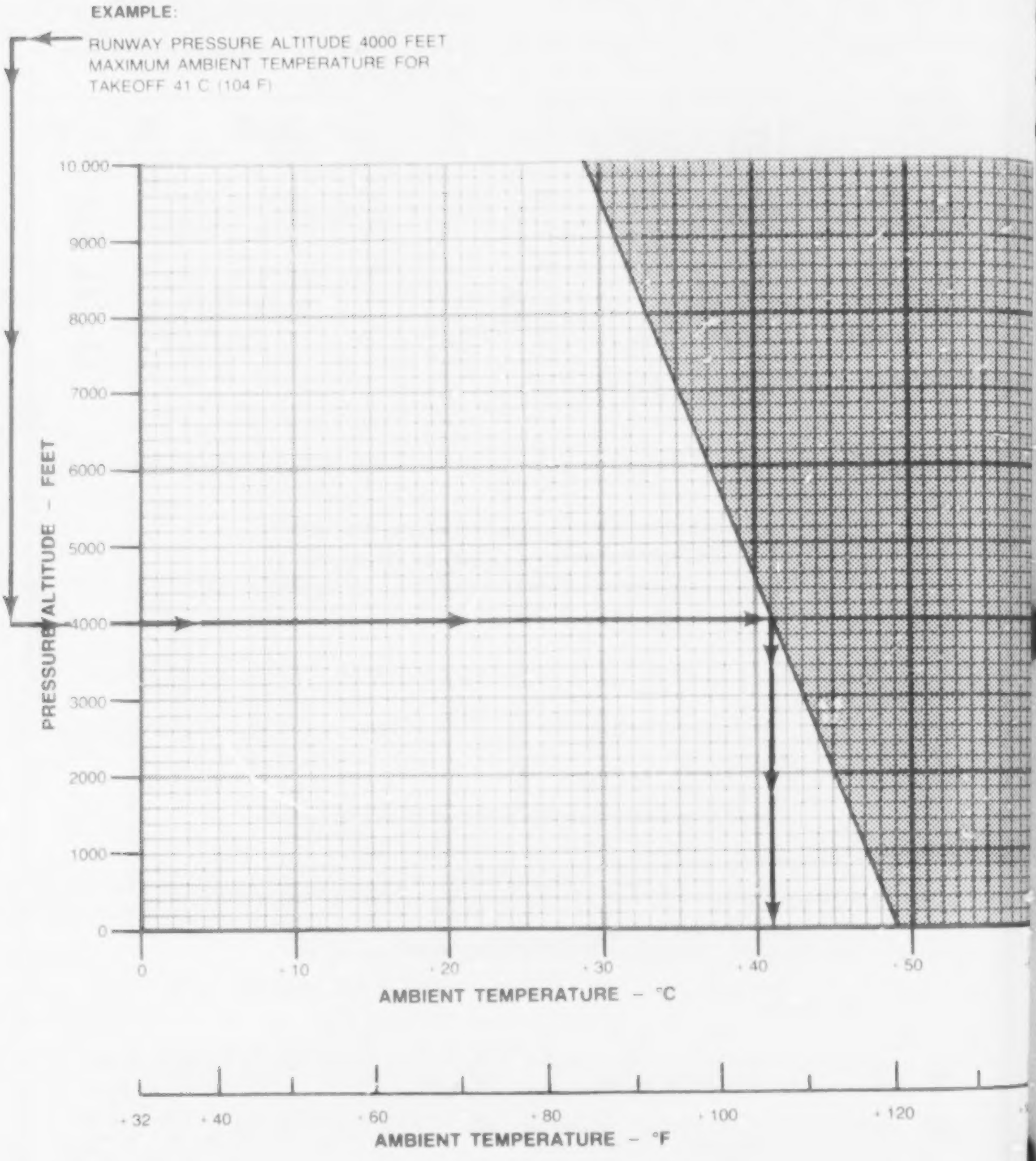


Figure 5-2. Takeoff Temperature Limitations

SECTION IV. LOADING LIMITS

5-15. Center-of-Gravity Limitations.

CAUTION

When oxygen bottles are not installed in rear cabin, check aircraft loading to avoid exceeding forward CG limit. Flight operations involving forward loadings while the oxygen bottles are removed are critical, i.e., pilot and copilot only or forward loaded cargo and/or passengers.

Center-of-gravity limits and instructions for computation of the center of gravity are contained in chapter 6.

5-16. Weight Limitations.

The maximum designed gross weight if 9650 pounds for takeoff and 9168 pounds for landing. Maximum ramp weight is 9705 pounds.

5-17. Floor Loading Limits.

The floor is stressed to support a maximum vertical load of 200 pounds per square foot on the seat tracks. Secondary supports should be used to distribute highly condensed weights evenly over the cargo areas.

SECTION V. AIRSPEED LIMITS

5-18. Airspeed Limitations.

Airspeed indicator readings contained in procedures, test, and illustrations throughout the Operators Manual are given as indicated airspeed (IAS) Airspeed indicator markings (fig. 5-1) and placarded airspeeds, located on the cockpit overhead control panel (fig. 2-21), are calibrated airspeed (CAS). Refer to the Airspeed Calibration Chart in chapter 7.

5-19. Maximum Allowable Airspeed V_{mo}.

The maximum allowable airspeed under all conditions is 208 KCAS (208 KIAS) V_{mo}. Operation above this speed may cause structural damage.

5-20. Turbulence Penetration Speed.

The maximum safe penetration speed in severe turbulence is 169 KCAS (168 KIAS).

5-21. Landing Gear Extension Speed.

The airspeed limit for extending the landing gear and for flight with the landing gear extended is 156 KCAS (154 KIAS). Above this speed, air loads may damage the landing gear doors or their operating mechanisms.

5-22. Landing Gear Retraction Speed.

The airspeed limit for retracting the landing gear s 130 KCAS (127 KIAS). If the landing gear is retracted above this speed, air loads may damage the landing gear operating mechanism.

5-23. Wing Flap Extension Speeds.

The airspeed limit for lowering the flaps to the approach position (35%) is 174 KCAS (173 KIAS). The airspeed limit for extending the flaps from the approach position to the full down, or any intermediate position is 130 KCAS (127 KIAS). If indicated airspeeds exceed these limitations the flaps or their operating mechanisms may be damaged.

5-24. Cockpit Vent/Storm Window Speed.

No airspeed limitations are imposed on cockpit vent/storm windows.

5-25. Minimum Single-Engine Control Airspeed (V_{mc}).

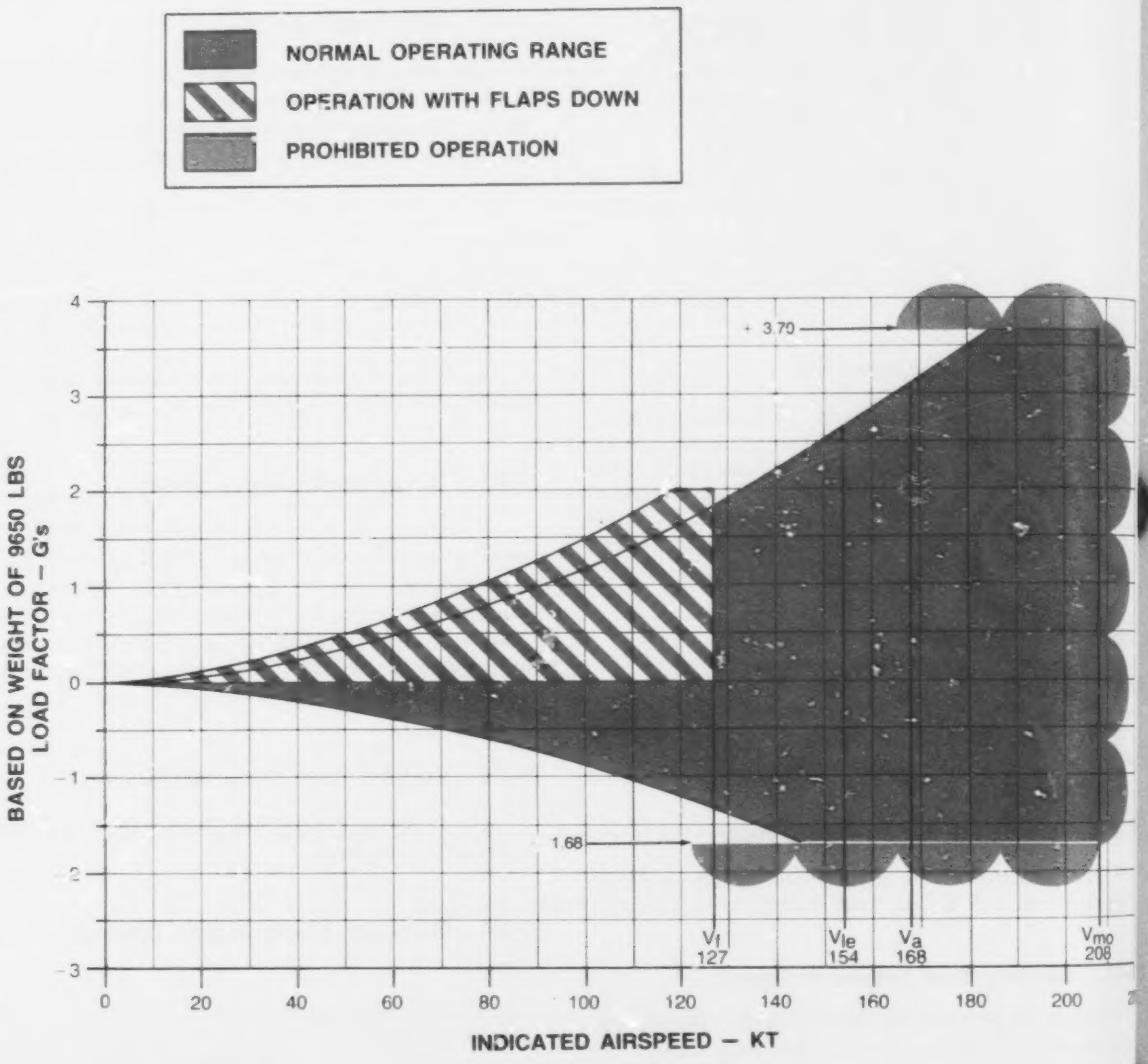
The placard V_{mc} airspeed of 92 knots is the calibrated airspeed value for sea level standard day conditions. For V_{mc} as a function of pressure altitude and atmospheric temperature, refer to Chapter 7, Section X.

5-26. Maximum Design Maneuvering Speed V_a.

The maximum design maneuvering speed is 169 KCAS (168 KIAS).

FLIGHT ENVELOPE

FLIGHT ENVELOPE
U-21A
T74-CP-700



V_f - DESIGN FLAP SPEED

V_a - DESIGN MANUVERING SPEED

V_{le} - DESIGN GEAR EXTENDED SPEED

V_{mo} - MAX OPERATING LIMIT SPEED

NOTE
BELOW 30,000 FEET, ALTITUDE VARIATIONS DO NOT AFFECT THE LIMITS SHOWN

Figure 5-3. Flight Envelope Chart

SECTION VI. MANEUVERING LIMITS

5-27. Maneuvers.

WARNING

Operation beyond the structural capabilities of the aircraft will result in complete failure of one or more airframe components.

a. The following maneuvers are prohibited.

(1) Spins.

(2) Aerobatics of any kind.

(3) Abrupt maneuvers above 169 KCAS (168 KIAS).

(4) Any maneuver which results in a positive load factor of 3.70G's or a negative load factor of 1.68G's with wing flaps up or a positive load factor of 2.0G's, or negative G's with wing flaps down.

b. The maximum design maneuvering speed is 169 KCAS (168 KIAS). For turbulent air penetration use an airspeed of 169 KCAS (168 KIAS). Avoid over action on power levers, turn off autopilot altitude hold, keep wings level, maintain attitude and avoid use of trim. Do not chase airspeed and altitude. Penetrations should be at an altitude which provides adequate maneuvering margins when severe turbulence is encountered.

5-28. Bank and Pitch Limits.

a. Bank limit is 60°.

b. Pitch limit is 30° above or below the horizon.

SECTION VII. ENVIRONMENTAL RESTRICTIONS

5-29. Altitude Limitations.

The maximum altitude that the aircraft may be operated at is 26,150 feet. The single engine service ceiling is 12,000 feet.

5-30. Autoignition During Night Operation.

Autoignition shall be used during night operations at or above 14,000 feet.

5-31. Flight Under IMC (Instrument Meteorological Conditions).

This aircraft is approved for flight under instrument conditions.

5-32. Wind Limitations.

The maximum demonstrated crosswind for landing is 25 knots. Refer to chapter 7 for wind limitations.

5-33. Oxygen Requirements.

One oxygen mask and an adequate supply of aviators breathing oxygen shall be provided each crewmember in compliance with AR95-1 for planned flight above 10,000 feet.

SECTION VIII. OTHER LIMITATIONS

5-34. Passenger Seats.

The forward passenger seat on each or either side of the aircraft may face aft, but only seats approved for aft facing installation may be installed facing aft. When an approved seat faces aft, the occupant shall not weigh more than 170 pounds. The headrest and set back, when occupied, must be in the fully upright position for takeoff and landing.

CHAPTER 6

WEIGHT/BALANCE AND LOADING

SECTION I. GENERAL

6-1. Extent of Coverage.

Sufficient data has been provided so that, knowing the basic weight and moment of the aircraft, any combination of weigh and balance can be computed.

6-2. Class.

Army Model U-21A is in Class 2. Additional directives governing weight and balance of Class 2 aircraft forms and records are contained in AR 95-16, TM 55-1500-342-23 and DA PAM 738-751.

6-3. Aircraft Compartment and Stations

The aircraft is separated into two compartments associated with loading of the aircraft. These compartments are the cockpit and the cabin (fig. 6-1).

SECTION II. WEIGHT AND BALANCE

6-4. Purpose.

The data to be inserted on weight and balance charts and forms are applicable only to the individual aircraft, the serial number of which appears on the title page of the booklet entitled WEIGHT AND BALANCE DATA supplied by the aircraft manufacturer and on the various forms and charts which remain with the aircraft. The charts and forms referred to in this chapter may differ in nomenclature and arrangement from time to time, but the principle on which they are based will not change.

6-5. Charts and Forms.

The standard system of weight and balance control require the use of several different charts and forms. Within this Chapter, the following are used:

a. Chart C -Basic Weight and Balance Record, DD Form 365-3 (fig. 6-2).

b. Form F -Weight and Balance Clearance Form F, DD Form 365-4 (Transport) (fig. 6-3).

6-6. Responsibility.

The aircraft manufacturer inserts all aircraft identifying data on the title page of the booklet entitled WEIGHT AND BALANCE DATA and on the various charts and forms. All charts, including one sample Weight and Balance Clearance Form F, if applicable, are completed at time of delivery. This record is the basic weight and balance data of the aircraft at delivery. All subsequent changes in weight and balance are compiled by the weight and balance technician.

6-7. Aircraft Weighings.

The aircraft must be weighted periodically as required by pertinent directives or when:

a. The pilot reports unsatisfactory flight characteristic (nose or tail heaviness).

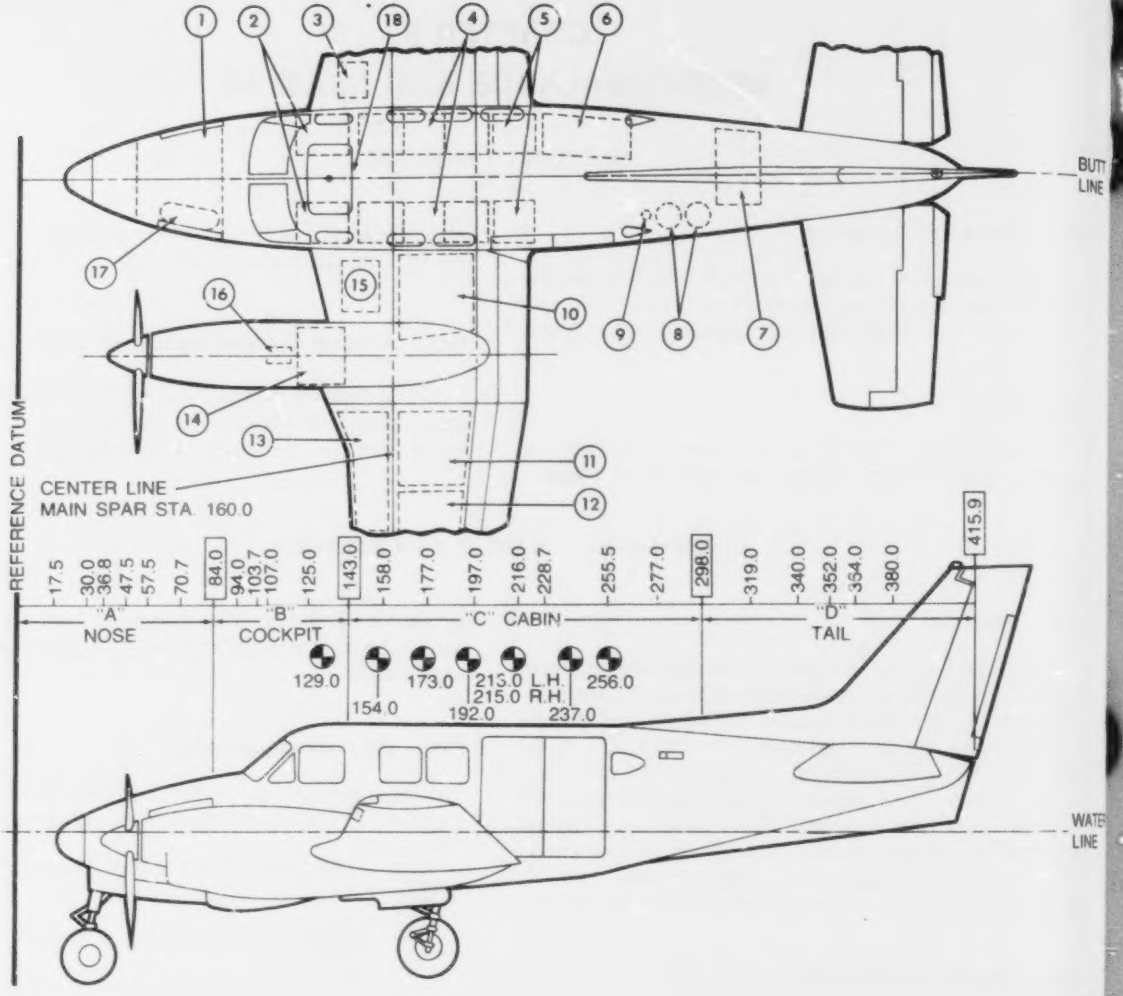
b. Major modifications or repairs are made.

c. The basic weight data contained in the records are suspected to be in error.

6-8. Weight Definitions.

Weight definitions are as follows:

a. Basic Weights. The basic weight of an aircraft is that weight which includes all fixed operating equipment and trapped fuel and oil. It is only necessary to add variable or expendable load items for various missions. The basic weight of an aircraft varies with structural modifications and changes in fixed operating equipment. The term basic weight, when qualified with a word indicating the type of missions such as Basic Weight for Combat, Basic Weight for Ferry etc., may be used in conjunction with directives stating what the equipment shall be for these missions. For example, extra fuel tanks and various items of equipment installed for long range


1
2
3
18
4
5
6
BUTT LINE
17
15
16
10
9
8
7
14
13
11
12
REFERENCE DATUM
CENTER LINE
MAIN SPAR STA. 160.0
17.5
30.0
36.8
47.5
57.5
70.7
84.0
94.0
103.7
107.0
125.0
143.0
158.0
177.0
197.0
216.0
228.7
255.5
277.0
298.0
319.0
340.0
352.0
364.0
380.0
415.9
"A"
NOSE
"B"
COCKPIT
"C" CABIN
"D"
TAIL
129.0
154.0
173.0
192.0
213.0 L.H.
215.0 R.H.
237.0
256.0
WATER LINE

◕ DENOTES OCCUPANTS CENTROID

① NOSE AVIONICS COMPARTMENT
② PILOT - COPILOTS SEATS
③ BATTERY (R WING ONLY)
④ THREE MAN TROOP SEAT (R & L)
⑤ ONE MAN TROOP SEAT (R & L)
⑥ TWO MAN TROOP SEAT
⑦ AFT AVIONICS SHELF
⑧ OXYGEN CYLINDER (64. CU. FT.)
⑨ OXYGEN CYLINDER (11 CU. FT.)
⑩ WING FUEL TANKS
⑪ WING FUEL TANKS
⑫ WING FUEL TANKS
⑬ WING FUEL TANKS
⑭ NACELLE FUEL TANK
⑮ STROBE BEACON POWER SU
⑯ STARTER-GENERATOR
⑰ OXYGEN CYLINDER (64 CU. FT
⑱ *COCKPIT EMERGENCY ENTRANCE/EXIT HATCH

AP 00

Figure 6-1. Aircraft Compartments and Stations

ferry flight which are not normally carried on combat missions will be included in Basic Weight for Ferry but not in Basic Weight for Combat.

b. Operating Weight. The operating weight is the basic weight of the aircraft, including the crew and all equipment required for the mission, but not including fuel or payload.

c. Gross Weight. The gross weight is the total weight of an aircraft and its contents.

(1) The takeoff gross weight is the operating weight plus the variable and expendable load items which vary with the mission.

(2) The landing gross weight is the takeoff weight minus the expended load items.

6-9. Balance Definitions.

Balance definitions are as follows:

a. Reference Datum. The reference datum is an imaginary vertical plane at, or forward of, the nose of the aircraft from which all horizontal distances are measured for balance purposes. Diagrams of each aircraft show this reference datum as balance station zero.

b. Arm. Arm, for balance purposes, is the horizontal distance in inches from the reference datum to the center-of-gravity of the item. Arm may be determined from the Aircraft Compartment and Station Diagram (fig. 6-1).

c. Moment. Moment is the weight of an item multiplied by its arm. Moment divided by a constant is generally used to simplify balance calculations by reducing the number of digits. For this aircraft, inches and moment/100 have been used.

d. Average Arm. Average arm is the arm obtained by adding the weights and adding the moments of a number of items and dividing the total moment by the total weight.

e. Basic Moment. Basic moment is the sum of the moments of all items making up the basic weight. When using data from an actual weighing of an aircraft, the basic moment is the total moment of the basic aircraft with respect to the reference datum.

f. Center-of-Gravity (CG). Center-of-gravity is the point about which an aircraft would balance if suspended. Its distance from the reference datum is found by dividing the total moment by the gross weight of the aircraft.

g. CG Limits. CG limits are the extremes of movement which the CG can have without making the aircraft unsafe to fly. The CG of the loaded aircraft must be within these limits at takeoff, in the air, and on landing.

6-10. Chart C — Basic Weight and Balance Record.

Chart C is a continuous history of the basic weight and moment resulting from structural and equipment changes made in service. At all times, the last weight and moment/1000 entry is considered the current weight and balance status of the basic aircraft (fig. 6-2).

6-11. Weight And Balance Clearance Form F, DD Form 365-4 (Transport).

a. General. Form F (fig. 6-3) is a summary of the actual disposition of load in the aircraft. It records the balance status of the aircraft step by step. It serves as a work sheet on which the weight and balance technician records the calculations and any corrections that must be made to ensure the aircraft will be within weight and CG limits. It is necessary to complete Form F prior to flight whenever an aircraft is loaded in a manner for which no previous valid Form F is available.

Form F sheets are expendable and can be replaced when exhausted. An original and carbon are prepared for each loading. The original sheet, carrying the signature of responsibility, should remain at the point of departure to serve as certificates of proper weight and balance as required by existing clearance directives. The duplicate copy must remain in the manual for the duration of the flight. On a cross-country flight this form aids the weight and balance technician at refueling bases and stopover stations.

b. Use Of Form F (DD Form 365-4) Insert the necessary information at the top of the form. In the blank spaces of the LIMITATIONS table, enter the maximum allowable gross weights for takeoff and landing obtained from the Weight Limitations in Chapter 5.

1. Ref 1. Enter the aircraft basic weight and moment/1000. Obtain these figures from the last entry on Chart C - Basic Weight and Balance Record (fig. 6-2).
2. Ref 2. Not applicable.
3. Ref 3. Enter weight and moment of crew. Use actual crew weights if available. Use appropriate values from Personnel Moment Chart (fig. 6-5).
4. Ref 4. Enter the weight and moment of the crew's baggage. Use Cargo Moment Chart (fig. 6-7), with weight and station locations appropriate for baggage loads.
5. Ref 5. Not applicable.
6. Ref 6. Not applicable.
7. Ref 7. Enter the weight and moment of any extra equipment. Use Cargo Moment Chart (fig. 6-7) with weight and station locations most appropriate for the extra equipment loads.

8. Ref 8. Not Applicable.

9. Ref 9. Enter the sum of the weights for Ref 1 through Ref 8 to obtain OPERATING WEIGHT.

10. Ref 10. Enter the number of gallons and weight of the takeoff fuel. The weight of fuel used in warmup and/or taxi will not be included. If JP-4 fuel at a density of 6.5 lbs/gal is being used, use Fuel Moment Chart (fig. 6-4) to determine fuel weight and mom/1000 figures. If other than JP-4 is being used, use the following procedures to obtain accurate fuel weight and mom/1000 figures from the Fuel Moment Chart and to record information on Form F:

    a. Assume 6.8 lbs/gal for JP-5 fuel or 6.0 lbs/gal for AVGAS 100/130.

    b. Multiply the total number of gallons of fuel in the aircraft times the computed fuel density figure - and thereby determine actual fuel weight.

    c. Use Fuel Moment Chart (Fig. 6-4) to determine mom/1000 figure.

    d. Enter the weight and corresponding mom/1000 figure in the corresponding columns of Ref 10. Also, enter a figure for the total fuel gallons known to be in the aircraft within the TAKEOFF FUEL (Gal) line of Ref 10.

11. Ref 11. Not applicable.

12. Ref 12. Enter the sum of the weights for Ref 9 through 11, inclusive, to obtain TOTAL AIRCRAFT WEIGHT.

    a. Determine the ALLOWABLE LOAD based on takeoff, landing or limiting wing fuel (Maximum Zero Fuel Weight) restrictions by use of the LIMITATIONS table in the lower left corner of the form, as follows:

    b. Enter the ALLOWABLE GROSS WEIGHT for TAKEOFF and LANDING. Since this aircraft has a gross weight restriction above which all weight must be fuel in the wings (e.g., Maximum Zero Fuel Weight), enter ALLOWABLE GROSS WEIGHT for LIMITING WING FUEL in the last column of the LIMITATIONS table.

    c. Enter the TOTAL AIRCRAFT WEIGHT from Ref 12. Estimate the fuel onboard at time of landing and enter the OPERATING WEIGHT from Ref 9 and OPERATING WEIGHT plus ESTIMATED LANDING FUEL weight from Ref 23.

    d. Subtract the above weights from the respective allowable gross weights to obtain the respective ALLOWABLE LOADS. The smallest of these figures is the ALLOWABLE LOAD representing the maximum amount of weight which may be distributed throughout the aircraft in various compartments without exceeding the limiting gross weights of the aircraft.

13. Ref 13. Using the same compartment letter designation as shown in figure 6-1, Aircraft Compartment and Stations, enter the number and weight of passengers, baggage and/or cargo. Use actual passenger weights if available. Enter the totals for each compartment in the appropriate columns.

NOTE

The sum of the compartment totals must not exceed the ALLOWABLE LOAD determined in the LIMITATIONS table.

14. Enter the sum of Ref 12 and the COMPARTMENT totals under Ref 13 opposite TAKEOFF CONDITION (Uncorrected). Calculate and enter the moment/1000 for Ref 1 through Ref 13, inclusive, using the tables as previously shown.

15. Check the weight figure, Ref 16, against the ALLOWABLE GROSS WEIGHT TAKEOFF in the LIMITATIONS table. Check the moment/constant figure opposite Ref 17 by means of the Balance Computer or Center of Gravity Moment Table to ascertain that the indicated CG is within allowable limits.

16. If changes in amount or distribution of load are required, indicate necessary

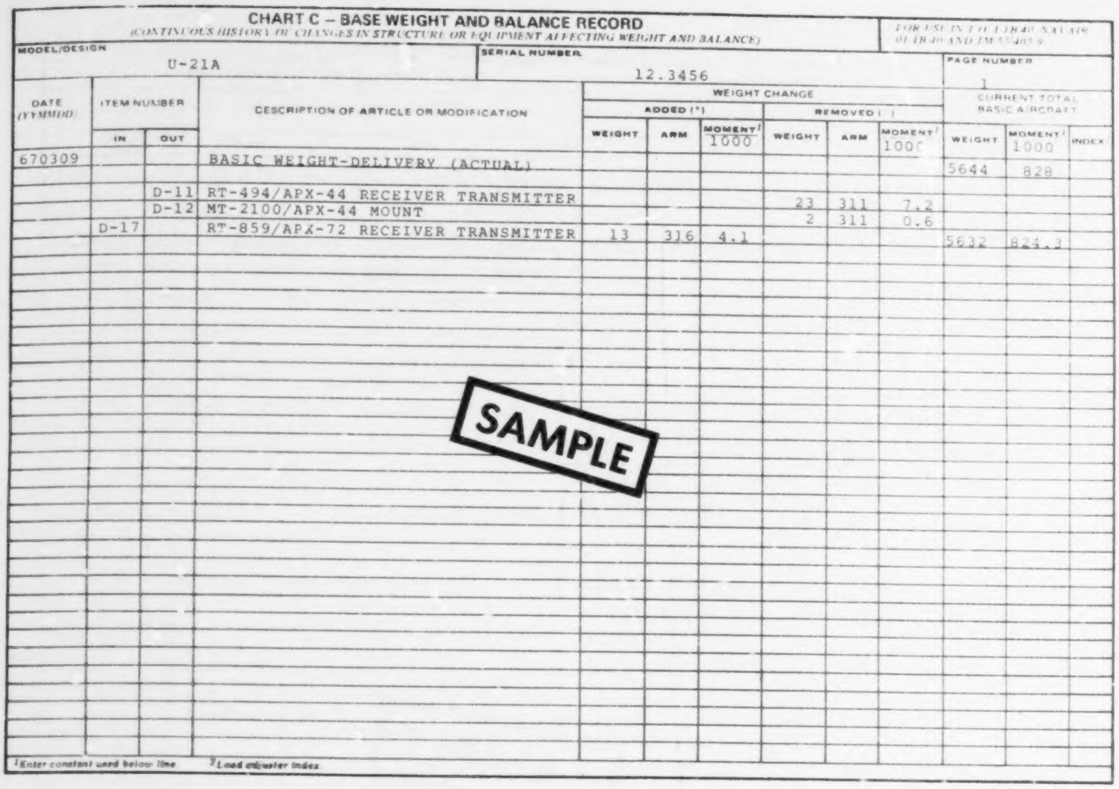


CHART C – BASE WEIGHT AND BALANCE RECORD
(CONTINUOUS HISTORY OF CHANGES IN STRUCTURE OR EQUIPMENT AFFECTING WEIGHT AND BALANCE)
FOR USE IN T.O. 1-1B-40, NAVAIR 01-1B-40 AND TM 55-405-9

MODEL/DESIGN: U-21A
SERIAL NUMBER: 12.3456
PAGE NUMBER: 1

DATE (YYMMDD)	ITEM NUMBER		DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT CHANGE						CURRENT TOTAL BASIC AIRCRAFT		
				ADDED (+)			REMOVED (-)					
	IN	OUT		WEIGHT	ARM	MOMENT[1] 1000	WEIGHT	ARM	MOMENT[1] 1000	WEIGHT	MOMENT[1] 1000	INDEX
670309			BASIC WEIGHT-DELIVERY (ACTUAL)							5644	828	
		D-11	RT-494/APX-44 RECEIVER TRANSMITTER				23	311	7.2			
		D-12	MT-2100/APX-44 MOUNT				2	311	0.6			
	D-17		RT-859/APX-72 RECEIVER TRANSMITTER	13	316	4.1				5632	824.3	

[1] Enter constant used below line [2] Load adjuster index

SAMPLE

AP013049

Figure 6-2. Basic Weight and Balance Record

adjustments by proper entries in the CORRECTIONS table. Enter a brief description of the adjustment made in the column marked ITEM. Add all the weight and moment decreases and insert the totals in the space opposite TOTAL WEIGHT REMOVED. Add all the weight and moment increases and insert the totals in the space opposite TOTAL WEIGHT ADDED. Subtract the smaller from the larger of the two totals and enter the difference (with applicable § or - sign) opposite NET DIFFERENCE. If a balance computer is used, the revised index for each correction item is entered. Transfer the NET DIFFERENCE figures to the spaces opposite Ref 18.

17. Ref 19. Enter the sum of, or the difference between, Ref 16 and Ref 18. Re-check to assure that these figures do not exceed allowable limits.

18. Ref 20. Referring to CG Moment Table of Chart E, or to CG grid on the Basic Computer, determine the corrected takeoff CG position. Enter this figure in the space provided opposite TAKEOFF CG.

19. Ref 21. Subtract TAKEOFF FUEL (Ref 10) from TAKEOFF CONDITION (Ref 19). Enter this figure together with moment/100 in space provided.

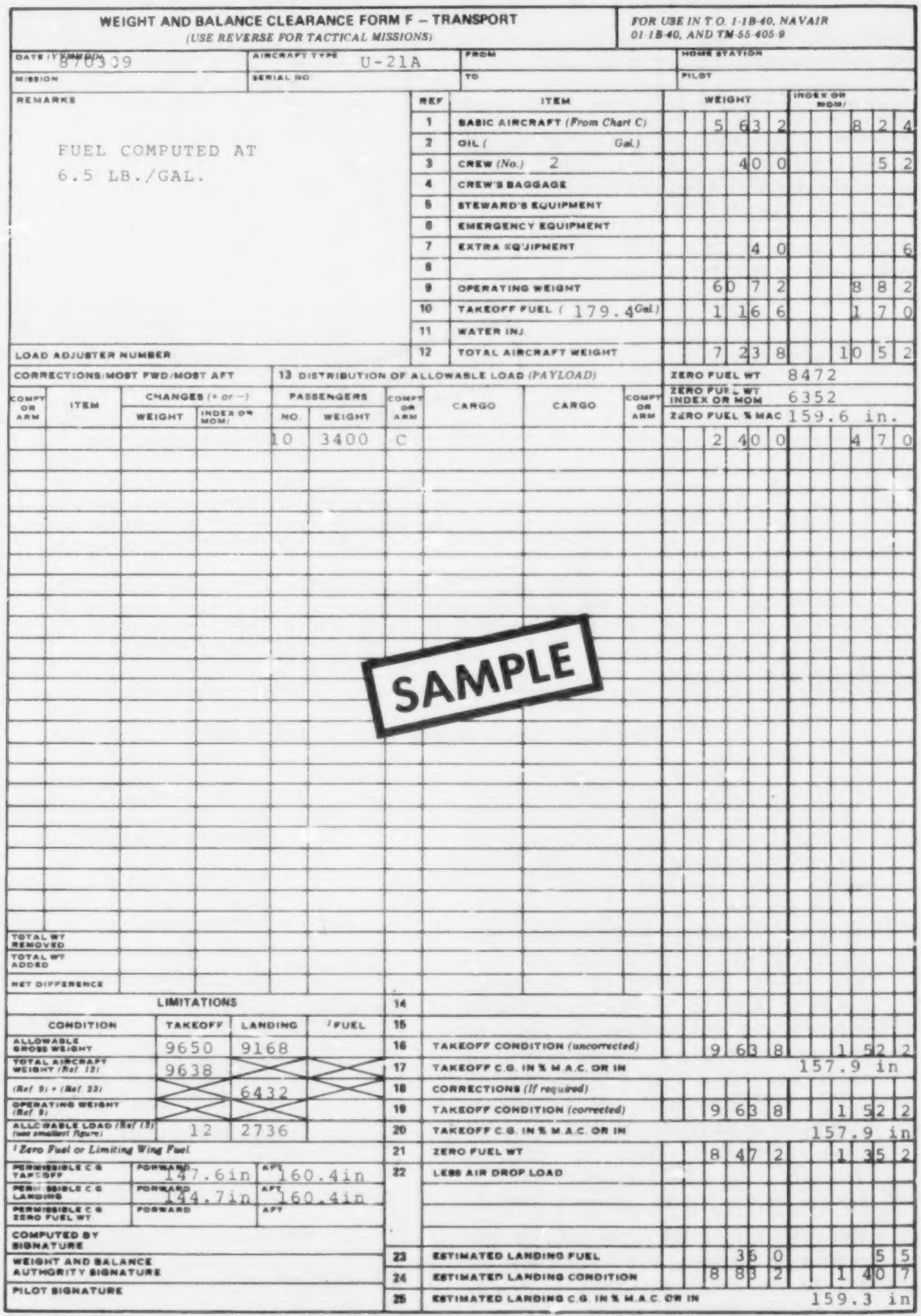
20. Ref 22. Not applicable.

21. Ref 23. Estimate the weight of fuel remaining on landing. Enter figure together with moment/1000 in the spaces provided.

NOTE

Do not consider reserve fuel as expended when determining ESTIMATED LANDING CONDITION.

22. Ref 24. Enter the sum of Ref 21 and Ref 23. Calculate and enter the moment/1000.



WEIGHT AND BALANCE CLEARANCE FORM F – TRANSPORT
(USE REVERSE FOR TACTICAL MISSIONS)

FOR USE IN T.O. 1-1B-40, NAVAIR 01-1B-40, AND TM 55-405-9

DATE (YYMMDD) 870309
AIRCRAFT TYPE U-21A
FROM
HOME STATION
MISSION
SERIAL NO
TO
PILOT

REMARKS
FUEL COMPUTED AT
6.5 LB./GAL.

LOAD ADJUSTER NUMBER

REF	ITEM	WEIGHT	INDEX OR MOM/
1	BASIC AIRCRAFT *(From Chart C)*	5632	824
2	OIL (*Gal.)*		
3	CREW *(No.)* 2	400	52
4	CREW'S BAGGAGE		
5	STEWARD'S EQUIPMENT		
6	EMERGENCY EQUIPMENT		
7	EXTRA EQUIPMENT	40	6
8			
9	OPERATING WEIGHT	6072	882
10	TAKEOFF FUEL (179.4 *Gal.)*	1166	170
11	WATER INJ.		
12	TOTAL AIRCRAFT WEIGHT	7238	1052

CORRECTIONS/MOST FWD/MOST AFT

13 DISTRIBUTION OF ALLOWABLE LOAD *(PAYLOAD)*

ZERO FUEL WT 8472
ZERO FUEL WT INDEX OR MOM 6352
ZERO FUEL % MAC 159.6 in.

COMPT OR ARM	ITEM	CHANGES *(+ or –)*		PASSENGERS		COMPT OR ARM	CARGO	CARGO	COMPT OR ARM	WEIGHT	INDEX OR MOM/
		WEIGHT	INDEX OR MOM/	NO.	WEIGHT						
				10	3400	C				2400	470
TOTAL WT REMOVED											
TOTAL WT ADDED											
NET DIFFERENCE											

LIMITATIONS

CONDITION	TAKEOFF	LANDING	¹FUEL
ALLOWABLE GROSS WEIGHT	9650	9168	
TOTAL AIRCRAFT WEIGHT *(Ref. 13)*	9638		
(Ref. 9) + (Ref. 23)		6432	
OPERATING WEIGHT *(Ref. 9)*			
ALLOWABLE LOAD *(Ref. 13) (use smallest figure)*	12	2736	

¹ Zero Fuel or Limiting Wing Fuel

	FORWARD	AFT
PERMISSIBLE C.G. TAKEOFF	147.6in	160.4in
PERMISSIBLE C.G. LANDING	144.7in	160.4in
PERMISSIBLE C.G. ZERO FUEL WT		

COMPUTED BY SIGNATURE
WEIGHT AND BALANCE AUTHORITY SIGNATURE
PILOT SIGNATURE

REF	ITEM	WEIGHT	INDEX OR MOM/
14			
15			
16	TAKEOFF CONDITION *(uncorrected)*	9638	1522
17	TAKEOFF C.G. IN % M.A.C. OR IN	157.9 in	
18	CORRECTIONS *(If required)*		
19	TAKEOFF CONDITION *(corrected)*	9638	1522
20	TAKEOFF C.G. IN % M.A.C. OR IN	157.9 in	
21	ZERO FUEL WT	8472	1352
22	LESS AIR DROP LOAD		
23	ESTIMATED LANDING FUEL	360	55
24	ESTIMATED LANDING CONDITION	8832	1407
25	ESTIMATED LANDING C.G. IN % M.A.C. OR IN	159.3 in	

SAMPLE

DD FORM 82 JAN 365-4 REPLACES DD FORM 365F, SEP 54, WHICH WILL BE USED.

☆U.S. Government Printing Office: 1983—786-043

AP013048

Figure 6-3. Weight and Balance Form DD 365F

23. Ref 25. By again referring to the CG Moment Table on Chart E or using the CG grid on the Balance Computer, determine the estimated landing CG position. Enter this figure opposite ESTIMATED LANDING CG.

24. The necessary signatures must appear in the appropriate spaces located at the lower left portion of the form.

SECTION III. FUEL/OIL

6-12. Fuel Load Fuel loading imposes a restriction on the amount of cargo which can be carried. The required fuel must first be determined, then that weight subtracted from the total weight of cargo and fuel. Cargo weights up to and including the remaining allowable capacity can be subtracted directly from the weight of cargo and fuel. As the fuel load is increased, the cargo capacity is reduced.

6-13. Fuel and Oil Data

a. Fuel Moment Chart (fig. 6-4). This chart shows fuel moment/1000 given gallons and pounds of JP-4 fuel.

b. Oil Data. Usable and unusable oil weight is included in the basic weight of the aircraft. Servicing information is provided in paragraph 2-84.

SECTION IV. PERSONNEL

6-14. Aircraft Personnel Cargo Features.

a. Cabin. The cabin extends from the back of the cockpit to the aft cabin wall. This area, when completely stripped of seating provisions, provides as 230.0 cubic foot cargo space with maximum measurements of 155.0 inches long, 57.0 inches high and 55.0 inches wide. Access is gained through the receptacle main entrance door which measures 51.5 inches high and 26.5 inches wide. In conjunction with the main entrance door, a cargo door is provided to give an opening of 51.5 inches high and 53.5 inches wide. The floor is designed to withstand cargo loads of 200 pounds per square foot. Refer to Section V to determine maximum cargo capacity and load position. Payload, must be limited in conjunction with fuel loading to stay within the design gross weight limitations.

b. Troop Cargo Features. The troop transport version is designed to carry 10 combat-equipped troops on center-facing bench-type seats (fig. 6-6, sheet 1).

NOTE

The forward passenger seat on each or either side of the aircraft may face aft but only seats approved for an aft-facing installation may be installed facing aft. When an approved seat faces aft, the aft-facing occupant shall weigh not more than 170 pounds.

c. Air Ambulance Cargo Features. The air ambulance version is equipped for three litters and has three seat positions. Two litters are to be placed one above the other, on the right aft side of the cabin, and one litter on the left side of the cabin. One three-man bench seat is provided at the forward right side of the compartment for ambulatory patients or medical personnel (fig 6-6, sheet 2).

d. Staff Transport Features. In staff transport service, two versions of staff transport cabin seating arrangements are available. The first version has three forward-facing chair seats secured to the floor railings on each side of the center aisle (fig. 6-6, sheet 4).

6-15. Personnel Loading and Unloading.

a. Troop Seat Installation. The center facing bench seats are fastened to the sidewall and to the inboard seat rail. See chapter 2 for a description of seat installation

b. Cabin Safety Belts and Harnesses. The troop transport and air ambulance versions are not equipped with cabin occupant restraints other than those built into the litters. The staff transport versions are equipped with lap belts attached to the seat tracks.

c. Comfort and Emergency Provisions. The entire cabin is padded and there are air vents, lights, and oxygen outlets in the ceiling. A relief tube is located just aft of the main entrance door. A fire extinguisher is located under the copilot's seat. For description and operation of emergency exists see chapter 9.

d. Litters. The air ambulance version is readied by removing or folding all troop bench seats, except one three-man seat unit for medical attendants, and installing one single letter bed and one double-deck litter bed unit (3 litters) in the cabin.

FUEL MOMEN
U-21A
T74-CP-700

FUEL MOMENT CHART

EXAMPLE

WANTED

FUEL MOMENT/1000

KNOWN

FUEL ON BOARD
1640 POUNDS

METHOD

ENTER FUEL
WEIGHT HERE
MOVE RIGHT
MOVE DOWN
READ FUEL
MOMENT/
1000 = 248

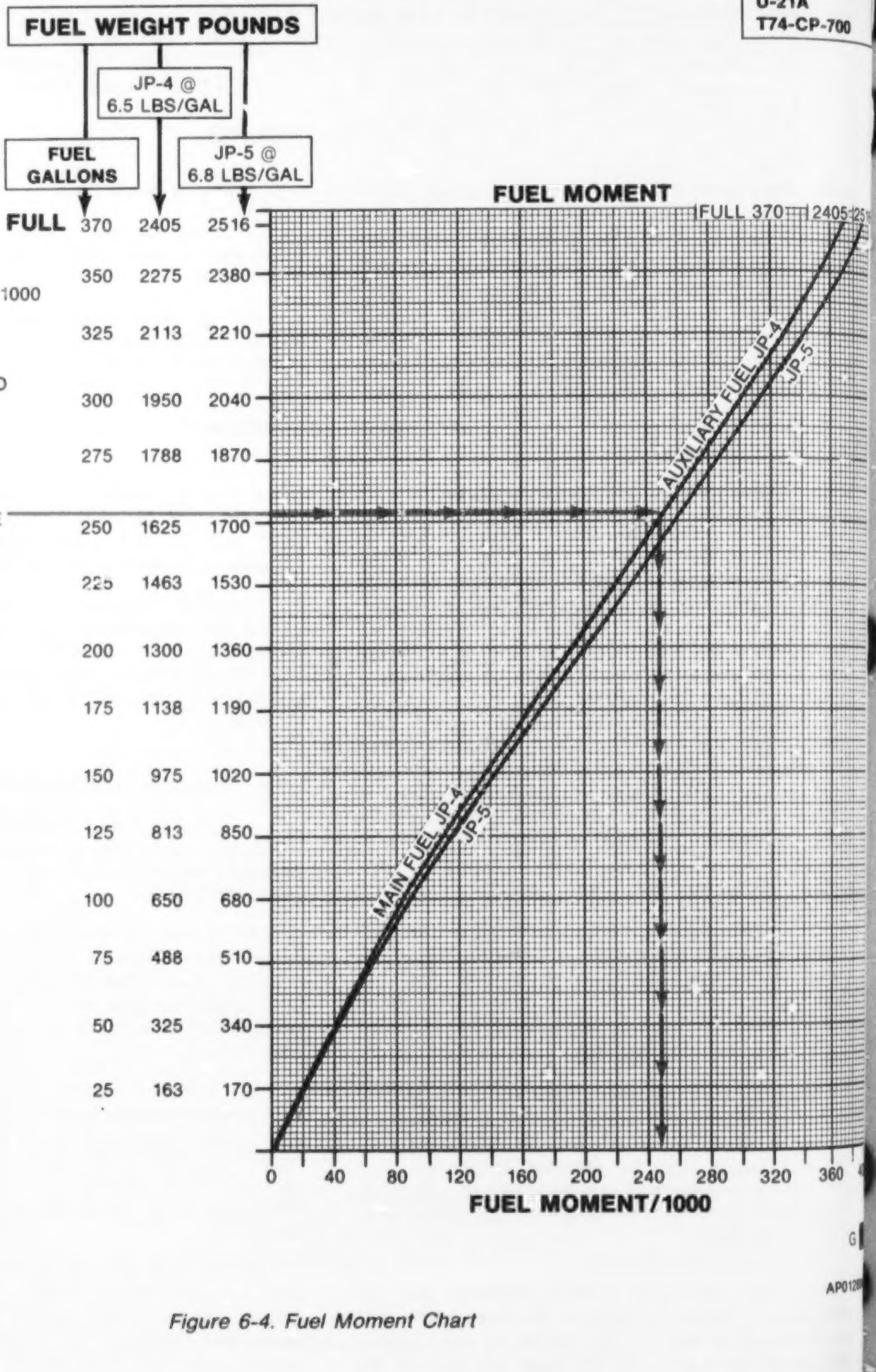


Figure 6-4. Fuel Moment Chart

PERSONNEL MOMENTS

STAFF TRANSPORT

PERSONNEL MOMENT
U-21A
T74-CP-700

EXAMPLE

WANTED

PERSONNEL MOMENT

KNOWN

PERSONNEL WEIGHT = 190 POUNDS,
SEAT POSITION IS PILOT-COPILOT
SEAT (POSITION 1)

METHOD

ENTER WEIGHT AT EACH SEAT
POSITION HERE
MOVE RIGHT TO SEAT POSITION
MOVE DOWN, READ MOMENT = 24.5

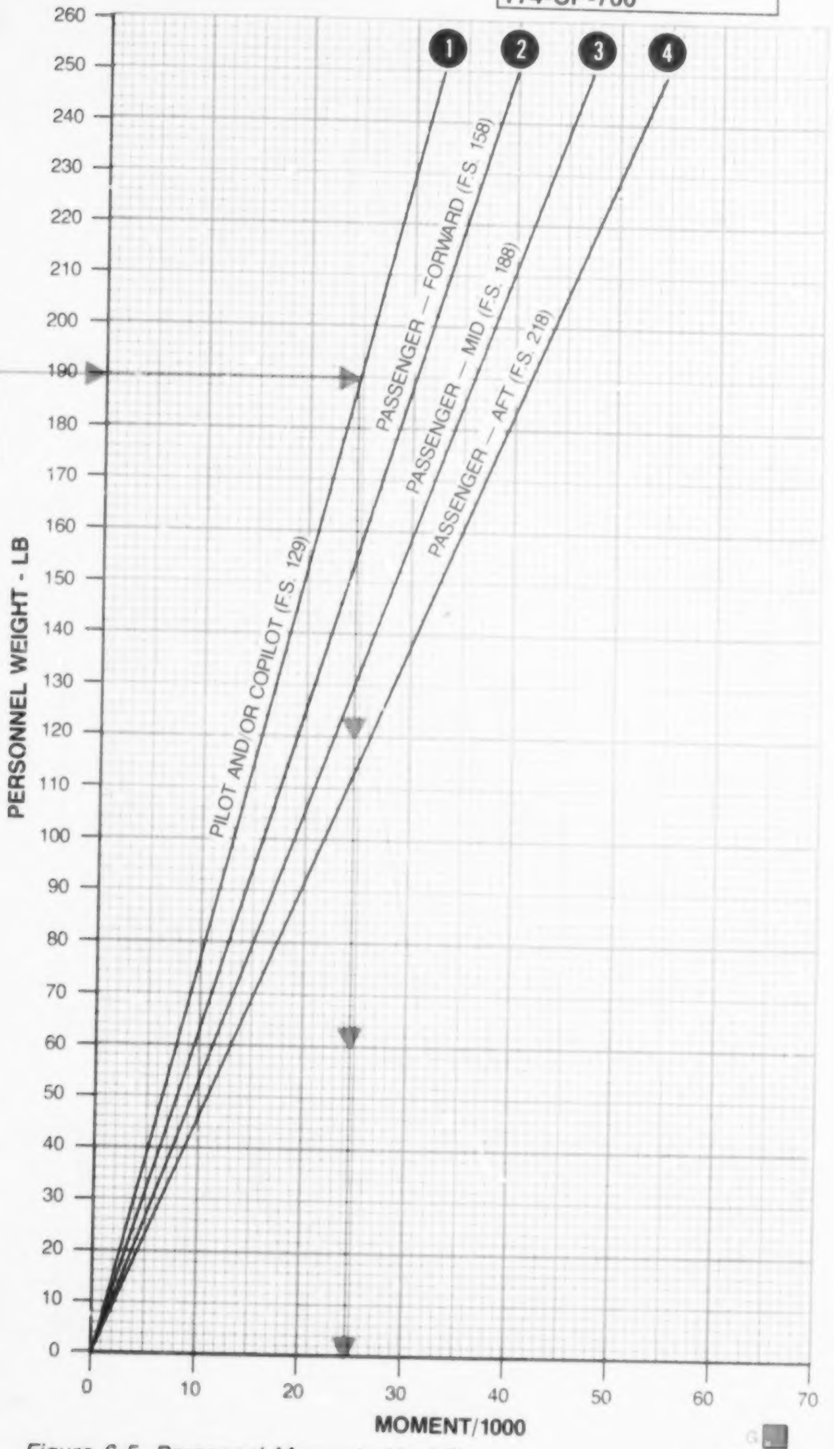


Figure 6-5. Personnel Moments (1 of 3)

AP 001540 1

PERSONNEL MOMENTS
AMBULANCE CONFIGURATION

EXAMPLE

WANTED

PERSONNEL MOMENT

KNOWN

PERSONNEL WEIGHT = 190 POUNDS,
SEAT POSITION IS PILOT-COPILOT SEAT (POSITION 1)

METHOD

ENTER WEIGHT AT EACH SEAT POSITION HERE
MOVE RIGHT TO SEAT POSITION
MOVE DOWN, READ MOMENT = 24.5

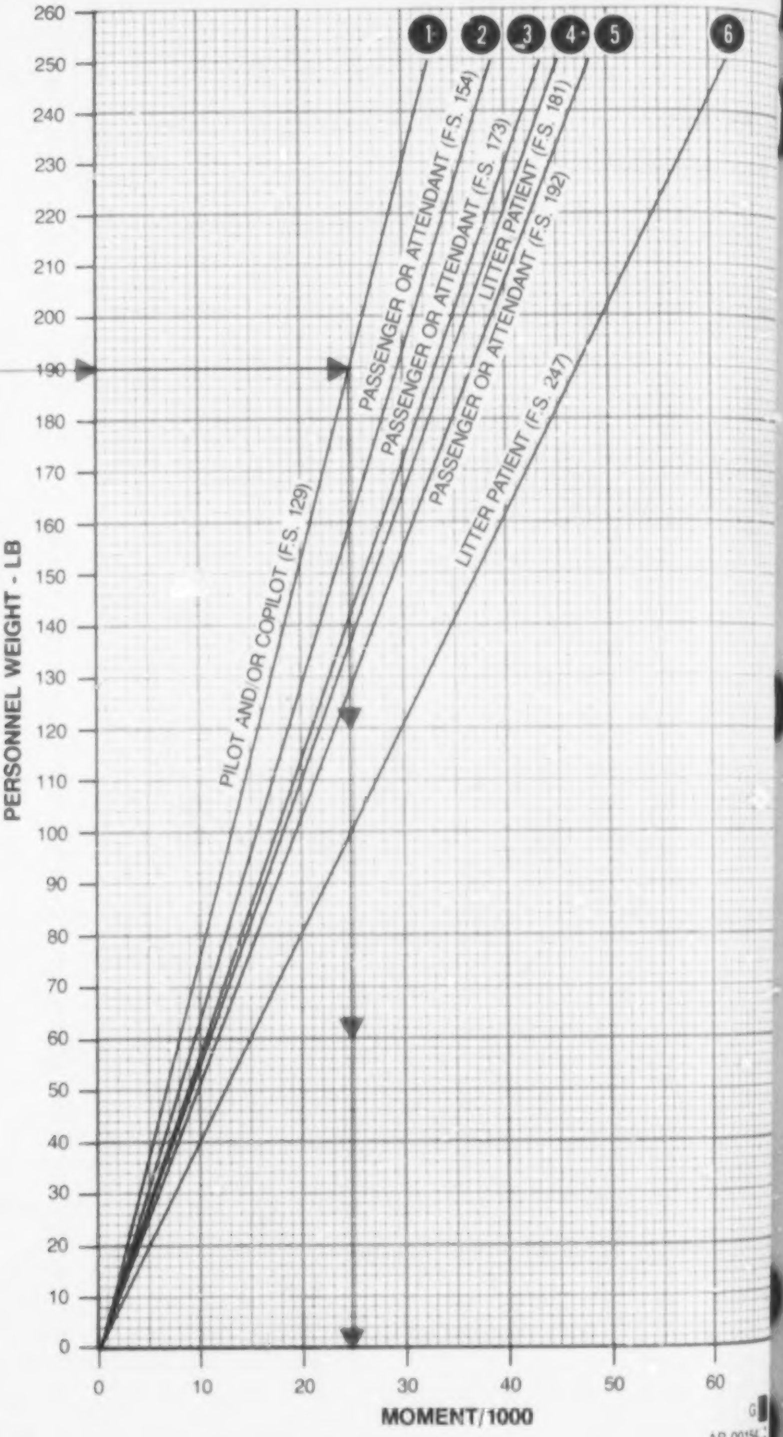


Figure 6-5. Personnel Moments (2 of 3)

PERSONNEL MOMENTS
TROOP CONFIGURATION

PERSONNEL MOMENT
U-21A
T74-CP-700

EXAMPLE

WANTED

PERSONNEL MOMENT

KNOWN

PERSONNEL WEIGHT = 190 POUNDS, SEAT POSITION IS PILOT-COPILOT SEAT (POSITION 1)

METHOD

ENTER WEIGHT AT EACH SEAT POSITION HERE
MOVE RIGHT TO SEAT POSITION
MOVE DOWN, READ MOMENT = 24.5

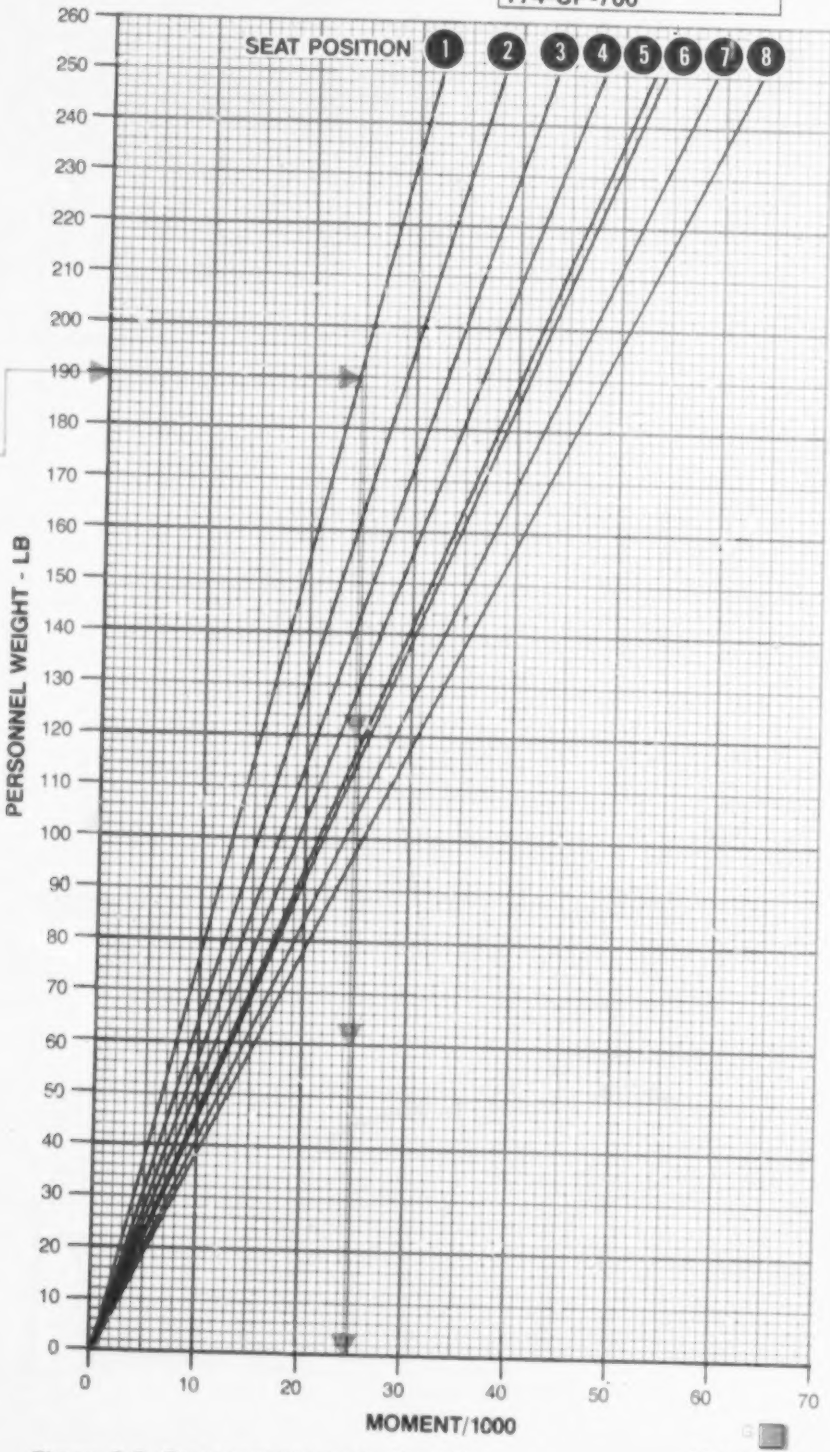
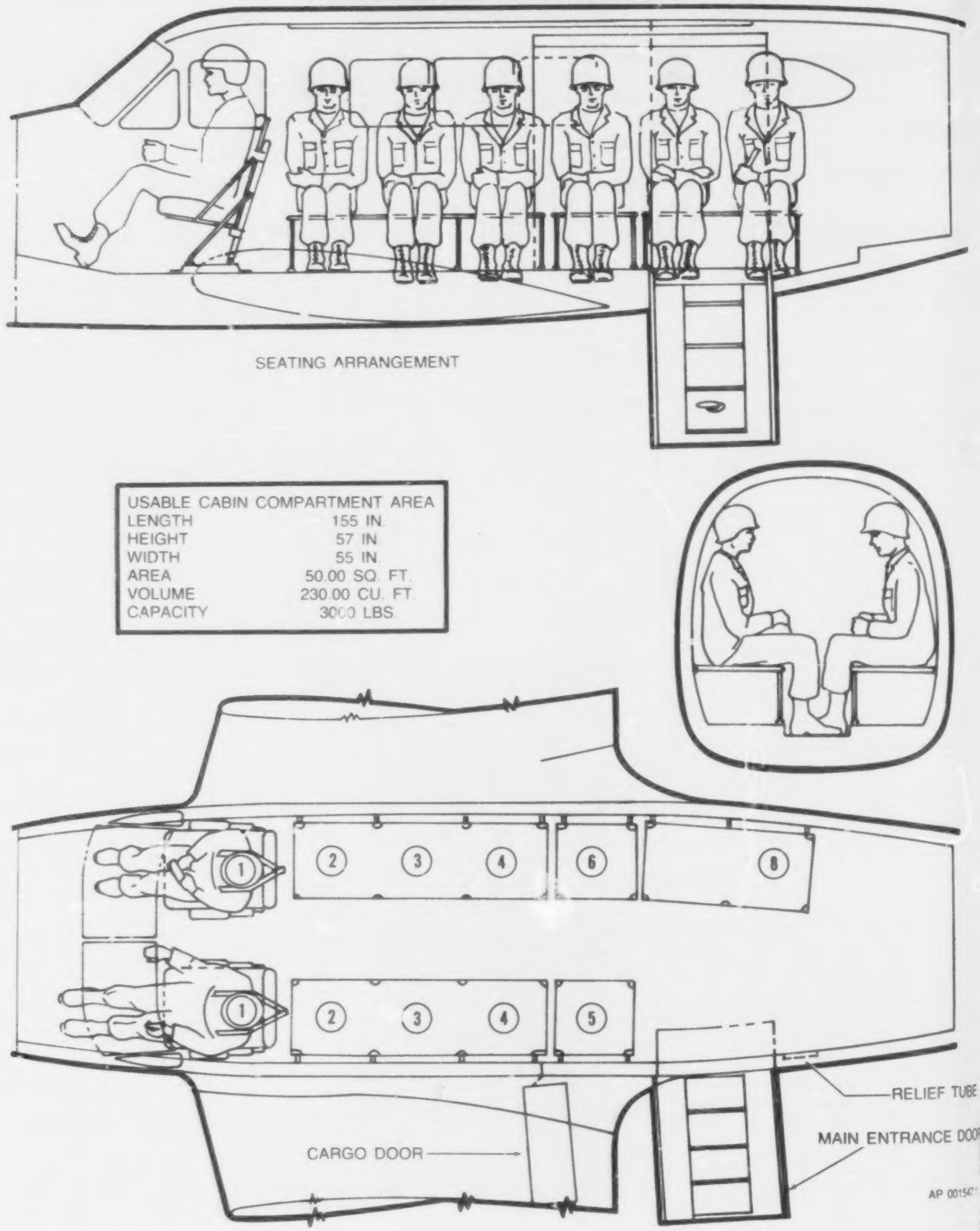


Figure 6-5. Personnel Moments (3 of 3)

AP 001540.3

TROOP TRANSPORT CONFIGURATION

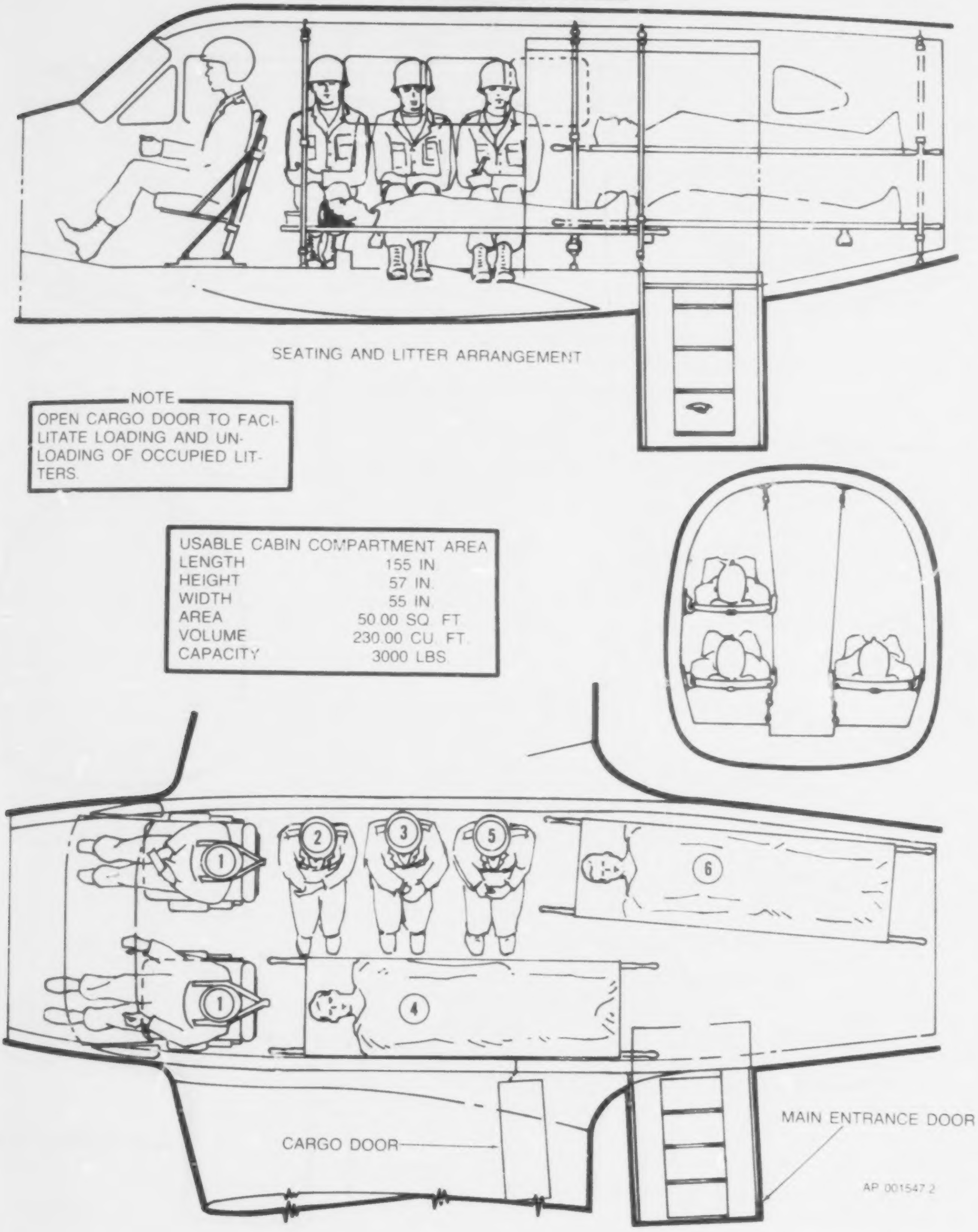


USABLE CABIN COMPARTMENT AREA	
LENGTH	155 IN.
HEIGHT	57 IN.
WIDTH	55 IN.
AREA	50.00 SQ. FT.
VOLUME	230.00 CU. FT.
CAPACITY	3000 LBS.

SEATING ARRANGEMENT
1
2
3
4
6
8
1
2
3
4
5
RELIEF TUBE
MAIN ENTRANCE DOO
CARGO DOOR
AP 00154

Figure 6-6. Personnel Loading (1 of 4)

AIR AMBULANCE VERSION


SEATING AND LITTER ARRANGEMENT
1
2
3
5
6
1
4
CARGO DOOR
MAIN ENTRANCE DOOR
AP 001547.2

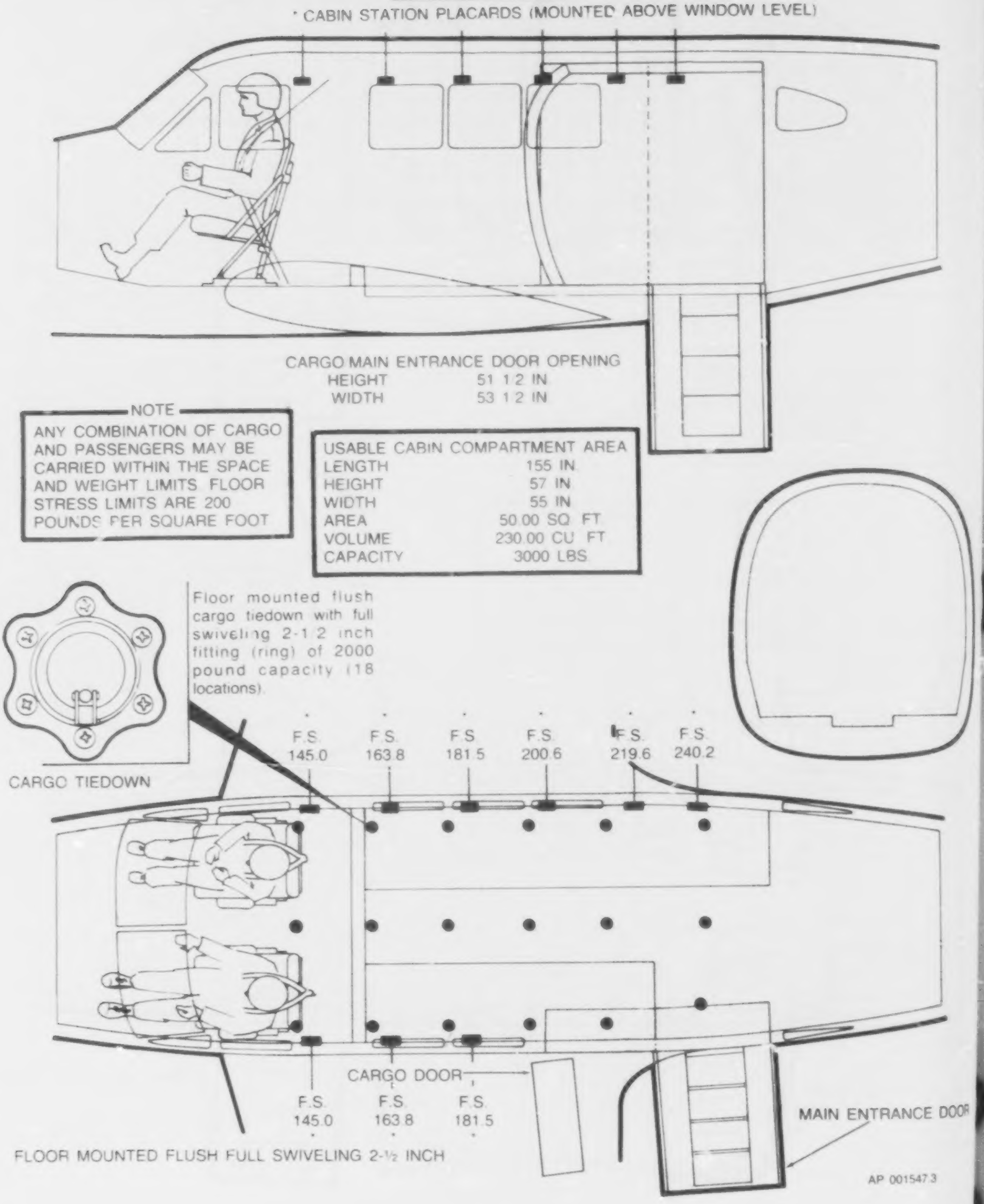
NOTE

OPEN CARGO DOOR TO FACILITATE LOADING AND UNLOADING OF OCCUPIED LITTERS.

USABLE CABIN COMPARTMENT AREA	
LENGTH	155 IN.
HEIGHT	57 IN.
WIDTH	55 IN.
AREA	50.00 SQ. FT.
VOLUME	230.00 CU. FT.
CAPACITY	3000 LBS.

Figure 6-6 Personnel Loading (2 of 4)

CARGO VERSION


* CABIN STATION PLACARDS (MOUNTED ABOVE WINDOW LEVEL)
CARGO TIEDOWN
F.S. 145.0
F.S. 163.8
F.S. 181.5
F.S. 200.6
F.S. 219.6
F.S. 240.2
CARGO DOOR
F.S. 145.0
F.S. 163.8
F.S. 181.5
MAIN ENTRANCE DOOR
FLOOR MOUNTED FLUSH FULL SWIVELING 2-½ INCH
AP 001547.3

CARGO MAIN ENTRANCE DOOR OPENING	
HEIGHT	51 1/2 IN.
WIDTH	53 1/2 IN.

NOTE

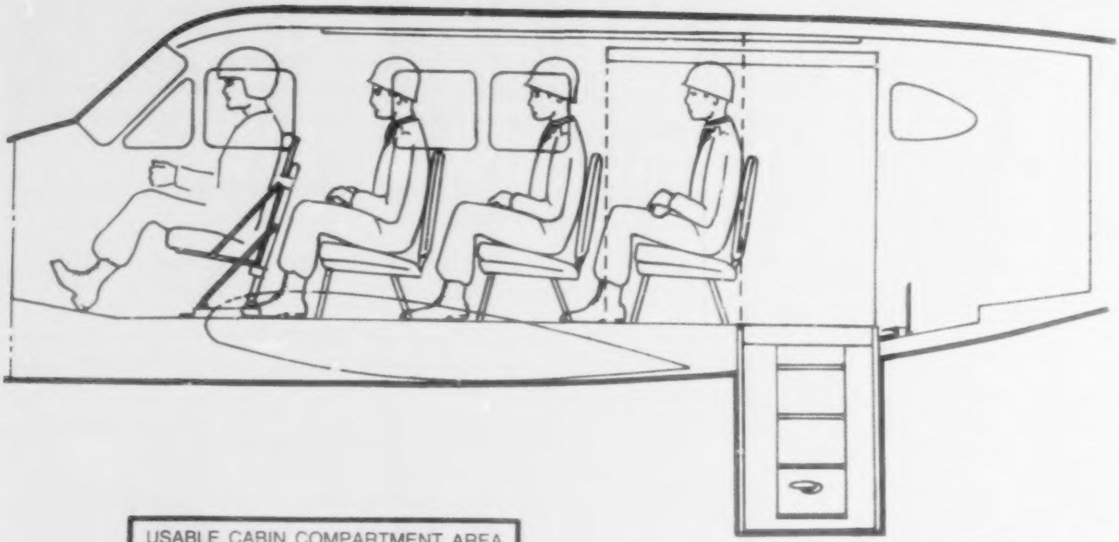
ANY COMBINATION OF CARGO AND PASSENGERS MAY BE CARRIED WITHIN THE SPACE AND WEIGHT LIMITS. FLOOR STRESS LIMITS ARE 200 POUNDS PER SQUARE FOOT.

USABLE CABIN COMPARTMENT AREA	
LENGTH	155 IN.
HEIGHT	57 IN.
WIDTH	55 IN.
AREA	50.00 SQ. FT.
VOLUME	230.00 CU. FT.
CAPACITY	3000 LBS.

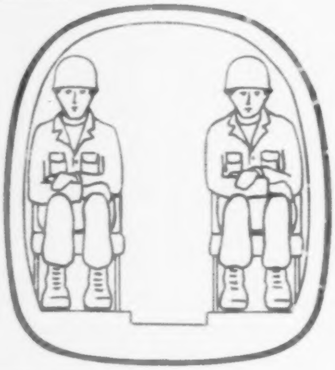
Floor mounted flush cargo tiedown with full swiveling 2-1/2 inch fitting (ring) of 2000 pound capacity (18 locations).

Figure 6-6. Personnel Loading (3 of 4)

STAFF TRANSPORT VERSION



USABLE CABIN COMPARTMENT AREA	
LENGTH	156 IN.
HEIGHT	57 IN.
WIDTH	55 IN.
AREA	50.00 SQ. FT.
VOLUME	230.00 CU. FT.
CAPACITY	3000 LBS.



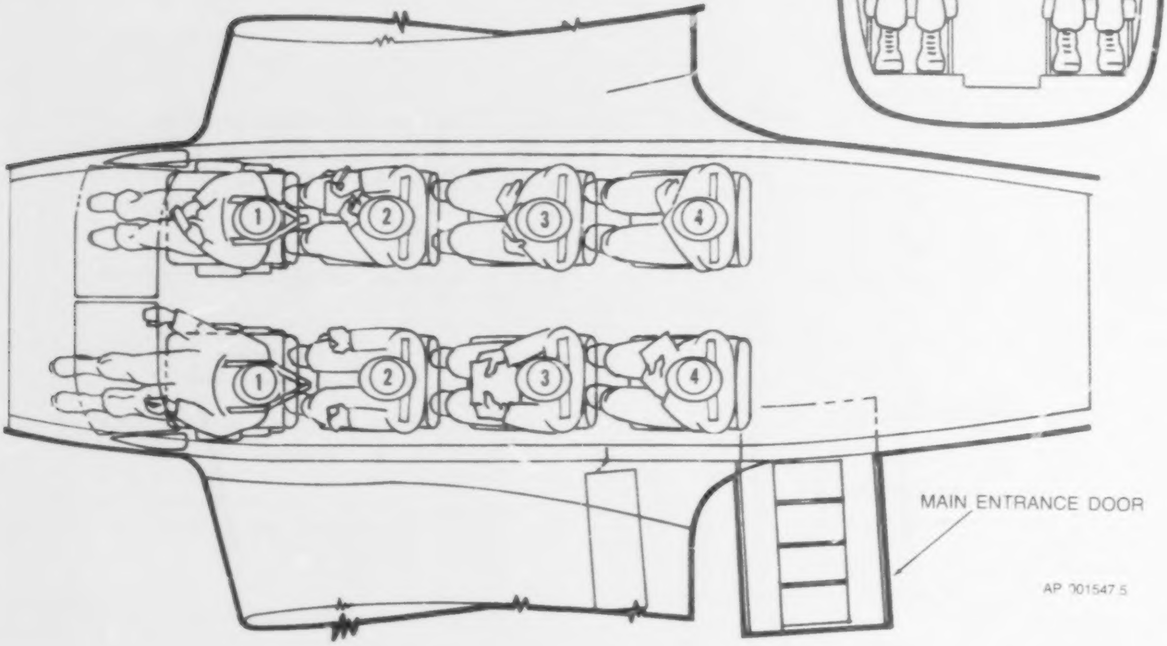

1
2
3
4
1
2
3
4
MAIN ENTRANCE DOOR
AP 001547.5

Figure 6-6 Personnel Loading (4 of 4)

The following procedure is recommended for loading litter patients in the Air Ambulance Version:

(1) Confirm the presence of installation plates for each litter bracket required (each litter requires two plates and two brackets).

(2) Confirm the presence of suspension straps and litter brackets.

(3) After patients have been strapped to the litters, load them in the following sequence:

(a) Top right side.

(b) Bottom right side.

(c) Left side.

(4) Confer with medical attendants to determine maximum altitude patients can endure (unless respirators are to be used).

(5) Inform medical attendants of any expected weather hazards (turbulence, etc.).

(6) Complete normal pre-flight briefing for medical attendants.

6-16. Personnel Load Computation.

When aircraft are operated at critical gross weights, the exact weight of each individual occupant plus equipment should be used. It weighing facilities are not available, or if the tactical situation dictates otherwise, loads shall be computed as follows:

a. Combat Equipped Soldiers: 240 lb. per individual.

b. Combat Equipped Paratroopers: 260 lb. per individual.

c. Crew and Passengers with no Equipment. complete weight according to each individual's estimate.

NOTE

Personnel loading configurations other than those shown in the Personnel Loading Diagram (fig. 6-6) shall be computed using Cargo Moment Chart in Section II.

SECTION V. CARGO LOADING

6-17. Air Cargo Features.

The aircargo version lacks seating within the cabin. Eighteen tiedown rings, which swivel within cuplike depressions, are provided in the compartment flooring. The cleared interior space accommodates varied cargo arrangements within the 3000 pound total and 200 pounds per square foot cargo limitations (fig. 6-6, sheet 3). The main entrance door measures 51.5 inches high and 26.5 inches wide. Loading work is facilitated by an outward opening cargo door which mates with the main entrance door. Opening both doors provides an entrance 51.5 inches high and 53.5 inches wide. The cabin has fittings for three litters (fig. 6-6, sheet 2).

6-18. Aerial Delivery System.

WARNING

Procedures for aerial delivery of personnel and cargo have not been developed. Paradrops with the standard 15-foot static line cannot be performed without the danger of interference of the trailing static line with the elevator control surface.

WARNING

The cargo door is a structural panel and shall be closed for flight.

A static line is provided along the center of the ceiling for equipment and personnel drop. The main entrance door (air-stair) may be removed, on the ground for personnel or cargo drops.

6-19. Cargo Center-of-Gravity Planning.

CAUTION

If the aft-mounted 64 cubic feet oxygen cylinder is removed and the nose-mounted 64 cubic feet oxygen cylinder is installed in the aircraft, ballast must be placed aft to hold the aircraft center-of-gravity within limits.

The cargo loading (fig.6-7) must be planned so that the center-of-gravity of the loaded aircraft will fall within the operating limits given in chapter 5. The allowable cargo center-of-gravity range is deter-

CARGO MOMENT

CARGO MOMENT
U-21A
T74-CP-700

EXAMPLE

WANTED

CARGO MOMENT

KNOWN

CARGO WEIGHT = 620 LB
CARGO LOCATION =
STA 180

METHOD

ENTER WEIGHT OF EACH ITEM OF CARGO HERE
MOVE RIGHT TO CARGO LOCATION
MOVE DOWN, READ MOMENT = 111.6

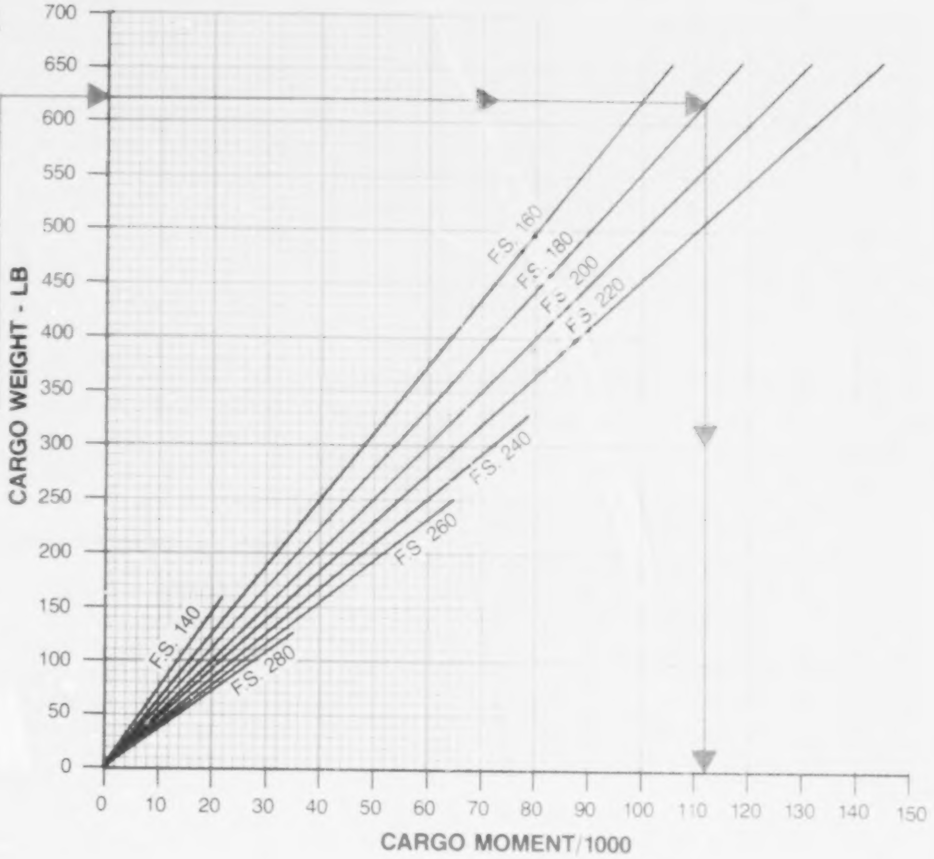


Figure 6-7. Cargo Moments

mined by these operating limits. All cargo capacities are based on the aircraft operating weight with all passenger seats removed. The weight and location of passengers and crew members must be considered when determining the cargo center-of-gravity location and cargo weight capacity. The maximum gross weight of the aircraft is 9650 pounds for takeoff and 9168 pounds for landing. The approximate total weight available for fuel and cargo/personnel, for each configurations, is as follows:

a. Troop Transport Version: approximately 3950 pounds available for crew, fuel and cargo/personnel.

b. Air Ambulance Version: approximately 3930 pounds available for crew, fuel and cargo/personnel

c. Staff Transport Version: approximately 3720 pounds available for crew, fuel and cargo/personnel.

d. Cargo Version: approximately 4110 pounds available for crew, fuel and cargo/personnel.

6-20. Cargo Center-of-Gravity Computation.

Table 6-1 shows an example of cargo center-of-gravity planning.

6-21. Preparation of General Cargo.

Before loading cargo, loading personnel should determine such data as weight, dimensions, center-of-gravity, and contact areas of the individual cargo items for use in positioning the load. For final load position of the aircraft see weight and balance computation in Section II.

6-22 Preparation of Cabin for Loading.

Air cargo conversion is made by removing the troop bench seats creating storage space within the cabin. Cargo tie-down fittings are flush-mounted in the floor structure.

6-23. Load Planning.

A thorough check by the pilot before each flight will insure the best loading arrangement. The amount of control surface deflection required to correct for forward or aft CG conditions will restrict maneuverability of the aircraft. The stability and controlability of the aircraft is improved, particularly at low airspeed, by loading as close to the neutral position as possible. The degree of load planning will vary with each operation, depending on the amount and bulk of the load. The basic factors to be considered in any loading situation are as follows:

a. The location of the cargo must be planned so that the center-of-gravity of the loaded aircraft will be within the operating limits.

b. The total weight of the loaded aircraft must not exceed the maximum allowable gross weight.

c. Cargo must be arranged to permit access to all emergency equipment and exits during flight.

d. Bulk cargo must be properly arranged to prevent damage to fragile items.

e. Floorboard and bulkhead structural capacity must be considered in the loading of heavy or sharp-edged containers and equipment. Secondary support should be used to distribute highly condensed weights evenly over the cargo areas.

f. Cargo destination should be considered when applicable. If part of the cargo is to be removed at an intermediate stop, the cargo should be arranged accordingly.

g. All cargo must be adequately secured to prevent damage to the aircraft, other cargo, or the item itself.

6-24. Loading Procedure.

Loading of cargo is accomplished through the main cabin entrance and cargo doors. Extreme caution should be exercised to prevent damaging the wing flaps, doors, floorboards, seat tracks, upholstery, etc. Personnel shall observe NO STEP areas. Cargo should have at least one secondary support on each side of the compartment. The floor is stressed to support a vertical load of 200 pounds per square foot.

6-25. Securing Loads.

Various aircraft maneuvers tend to move the cargo vertically, sideways, forward, rearward, or in any combination. For this reason all cargo must be secured with restraints strong enough to withstand the maximum force exerted in any direction. The maximum force can be determined by multiplying the weight of the cargo item by the applicable load factor. These established load factors (the ratio between the total force and the weight of the cargo item) are 1.5 to the side and rear, 3.0 up, 6.6 down, and 9.0 forward.

Table 6-1. Cargo Center-of-Gravity Location Planning Example.

ITEM	WEIGHT	STATION	MOMENT
Aircraft basic weight from chart c	5471	146.7	795316
Add: Fuel unusable	24	140	3360
Pilot	200	129	25800
Operating weight	5701	145.6	830132
Cargo (2000 pounds)	600	160	96000
Cargo	600	180	108000
Cargo	600	200	120000
Cargo	200	220	44000
Fuel (296 gallons)			
Nacelle fuel cell	741	131	97000
Wing fuel cell	1183	166	199000
Takeoff weight	9625	155.2	1494132

NOTES:

1. The cargo center-of-gravity is located at station 184.0. To get the landing weight of the aircraft down to a maximum of 9168 pounds, 457 pounds approximately (70 gallons) of fuel must be consumed.
2. This chart is for planning purposes only. Final aircraft loading operations and weight and balance computation must be checked for the particular aircraft. (See Section II)

6-26. Tiedown Devices.

18 recessed rings located in the floor are provided for tiedown. Each has a full swiveling 2-1/2 inch ring that is designed to take a 2000 pound load in any direction. (fig 6-6, sheet 3.)

6-27. Cargo Unloading.

Unloading of cargo will be accomplished through the main entrance door and the cargo door. Extreme caution must be exercised to prevent damaging the wings, wing flap, floorboards, seat tracks, upholstery, etc. Personnel shall observe NO STEP areas. After completing the unloading operation, check the aircraft for possible damage from loading, transporting, or unloading the cargo; the replace the passenger seats.

SECTION VI. CENTER OF GRAVITY

6-28. Center-of-Gravity Limitations.

Center-of-Gravity limits are expressed in ARM inches which refers to a positive measurement from the aircraft's reference datum. The forward CG limit is 144.7 ARM inches for all weights below 7400 pounds and tapers to 153.2 ARM inches at 9650 pounds. The aft CG limit is 160.4 ARM inches at all weights (fig. 6-8).

CENTER OF GRAVITY LIMITATIONS

CENTER-OF-GRAVITY LIMITATIONS
U-21A
T74-CP-700

EXAMPLE

WANTED

DETERMINE IF LOADING LIMITS ARE EXCEEDED

KNOWN

GW = 9300
MOMENT/1000 = 1479
ARM-INCHES = 159.0

METHOD

ENTER GROSS WEIGHT HERE
MOVE RIGHT TO TOTAL MOMENT = 1479, READ LOAD WITHIN LIMITS
MOVE DOWN READ ARM = 159.0

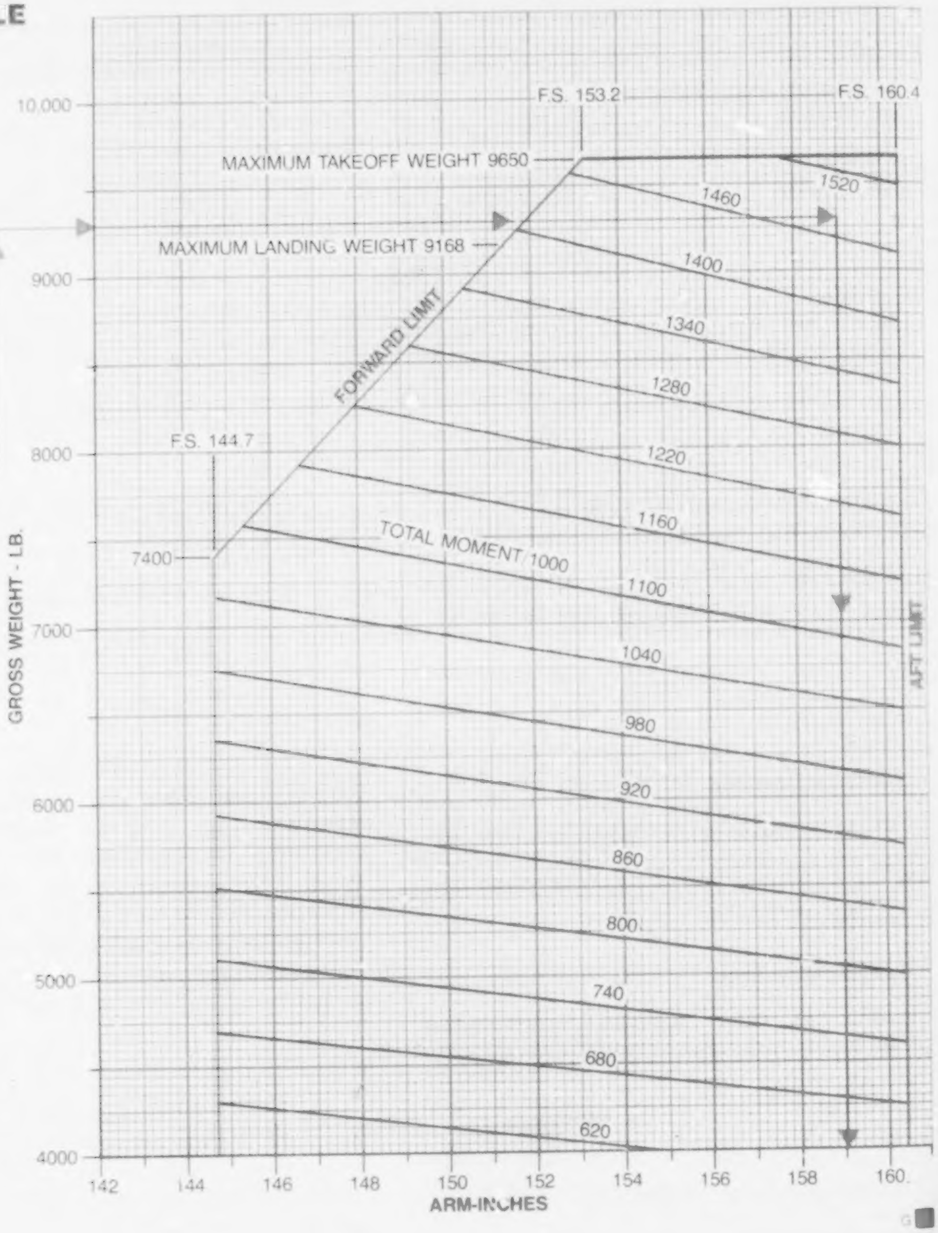


Figure 6-8. Center of Gravity

CHAPTER 7
PERFORMANCE DATE

SECTION I INTRODUCTION

7-1. Description.

The charts presented in this chapter are based on and are consistent with the recommended operating procedures and techniques set forth in other chapters of this manual. The charts contain the performance data necessary for preflight and inflight mission planning. Explanatory test applicable to each type of chart is included to illustrate the use of the data presented.

7-2. Purpose.

a. The purpose of this chapter is to provide the best available performance data for the U-21A aircraft. Regular use of this information will enable the pilot to receive maximum safe utilization from the aircraft. Although maximum performance is not always required, regular use of this chapter is recommended for the following reasons:

(1) Knowledge of performance margin will allow the pilot to make better decisions when unexpected conditions or alternate missions are encountered.

(2) Situations requiring maximum performance will be more readily recognized.

(3) Familiarity with the data will allow performance to be computed more easily and quickly.

(4) Experience will be gained in accurately estimating the effects of variables for which data are not presented.

b. The information is primarily intended for mission planning and is most useful when planning operations in unfamiliar areas or at extreme conditions. The date may also be used in flight, to establish unit or area standing operating procedures, and to inform ground commanders of performance/risk tradeoffs.

7-3. General. The data presented shall cover the maximum range of conditions and performance that can reasonably be expected. In each area of performance, the effects of altitude, temperature, gross weight, and other parameters relating to that phase of flight are presented. In addition to the presented data, the pilot's judgement and experience will be necessary to accurately obtain performance under a given set of circumstances. The conditions for the data are listed under the title of each chart. The effects of different conditions are discussed in the text accompanying each phase of performance. Where practical, data are presented at conservative conditions. However, NO GENERAL CONSERVATISM HAS BEEN APPLIED.

WARNING

Exceeding operating limits may cause permanent damage to critical components. Overlimit operation can decrease performance, cause immediate failure or failure on a subsequent flight.

7-4. Limits.

Applicable limits are shown on the charts as red lines. Performance generally deteriorates rapidly beyond limits. If limits are exceeded, minimize the amount and time. Enter the maximum valve and time limits on DA Form 2408-13 so proper maintenance action can be taken.

7-5. Chart Explanation.

A complete series of performance charts are provided for U-21A aircraft in this manual. These charts furnish the pilot with sufficient data to make an intelligent and safe flight plan. The charts include data on takeoff, climb, landing, and operating instructions for cruising flight from maximum endurance to normal rated power. No allowance has been made for navigational error, formation flight, or other contingencies. Appropriate allowances for these items should be dictated by local regulations and should be accounted for when the fuel available for cruise is determined. The charts are arranged to give maximum facility of use in preflight and inflight planning. All charts are based on free air temperature (FAT) conditions and pressure altitude.

7-6. Chapter 7 Index.

SECTION	TITLE	FIGURE NUMBER	CHART SUBJECT	PAGE NO.
I	Introduction	N/A	N/A	7-1
II	Performance Planning	7-1	Performance Planning Card	7-6
		7-2	Temperature Conversion/ Correction	7-8
		7-3	Airspeed Calibration-Normal System	7-10
		7-4	Airspeed Correction-Emergency System	7-11
		7-5	Altimeter Calibration-Normal System	7-12
		7-6	Altimeter Correction-Emergency System	7-13
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IV	Idle Fuel Flow	7-8	Idle Fuel Flow	7-17
V	Torque Available for Takeoff	7-9	Torque Available for Takeoff	7-19
VI	Normal Takeoff	7-10	Takeoff-Normal	7-21
VII	Normal Rotation/Takeoff Airspeed	7-11	Normal Rotation/Takeoff Airspeed	7-23
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IX	Accelerate-Stop Distance	7-13	Accelerater-Stop Distance	7-27
X	Minimum Single-Engine Control Airspeed	7-14	Minimum Single Engine Control Airspeed	7-29
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		7-25	Cruise FAT 50°C, Sea Level	7-51
		7-26	Cruise FAT -20°C, 4000 Ft	7-53
		7-27	Cruise FAT -10°C, 4000 Ft	7-55
		7-8	Cruise FAT 0°C, 4000 Ft	7-57
		7-29	Cruise FAT 10°C, 4000 Ft	7-59
		7-30	Cruise FAT 20°C, 4000 Ft	7-61
		7-31	Cruise FAT 30°C, 4000 Ft	7-63
		7-32	Cruise FAT 40°C, 4000 Ft	7-65
		7-33	Cruise FAT -30°C, 8000 Ft	7-66
		7-34	Cruise FAT -20°C, 8000 Ft	7-68
		7-35	Cruise FAT -10°C, 8000 Ft	7-70
		7-36	Cruise FAT 0°C, 8000 Ft	7-72
		7-37	Cruise FAT 10°C, 8000 Ft	7-74

SECTION	TITLE	FIGURE NUMBER	CHART SUBJECT	PAGE NO.
		7-38	Cruise FAT 20°C, 8000 Ft	7-76
		7-39	Cruise FAT 30°C, 8000 Ft	7-77
		7-40	Cruise FAT -30°C, 12,000 Ft	7-78
		7-41	Cruise FAT -20°C, 12,000 Ft	7-80
		7-42	Cruise FAT -10°C, 12,000 Ft	7-82
		7-43	Cruise FAT 0°C, 12,000 Ft	7-84
		7-44	Cruise FAT 10°C, 12,000 Ft	7-85
		7-45	Cruise FAT 20°C,c12,000 Ft	7-86
		7-46	Cruise FAT -40°C, 16,000 Ft	7-87
		7-47	Cruise FAT -30°C, 16,000 Ft	7-88
		7-48	Cruise FAT -20°C, 16,000 Ft	7-89
		7-49	Cruise FAT -10°C, 16,000 Ft	7-90
		7-50	Cruise FAT 0 °C, 16,000 Ft	7-91
		7-51	Cruise FAT 10°C, 16,000 Ft	7-92
		7-52	Cruise FAT 20°C, 16,000 Ft	7-93
		7-53	Cruise FAT -50°C, 20,000 Ft	7-94
		7-54	Cruise FAT -40°C, 20,000 Ft	7-95
		7-55	Cruise FAT -30°C, 20,000 Ft	7-96
		7-56	Cruise FAT -20°C, 20,000 Ft	7-97
		7-57	Cruise FAT -10°C, 20,000 Ft	7-98
		7-58	Cruise FAT 0°C, 20,000 Ft	7-99
		7-59	Cruise FAT 10°C, 20,000 Ft	7-100
		7-60	Cruise FAT -60°C, 24,000 Ft	7-101
		7-61	Cruise FAT -50°C, 24,000 Ft	7-102
		7-62	Cruise FAT -40°C, 24,000 Ft	7-103
		7-63	Cruise FAT -30°C, 24,000 Ft	7-104
		7-64	Cruise FAT -20°C, 24,000 Ft	7-105
		7-65	Cruise FAT -10°C, 24,000 Ft	7-106
		7-66	Cruise FAT -60°C, 25,000 Ft	7-107
		7-67	Cruise FAT -50°C, 25,000 Ft	7-108
		7-68	Cruise FAT -40°C, 25,000 Ft	7-109
		7-69	Cruise FAT -30°C, 25,000 Ft	7-110
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XV	Climb/Descent	7-71	Climb/Descent	7-113
VI	Approach Speed	7-72	Approach Speed	7-115
XVII	Landing	7-73	Landing	7-117

7-7. Color Coding.

The performance charts are color coded as follows:

a. Green: For example guidelines.

b. Red: Limit lines.

c. Yellow: Precautionary or time-limited operation.

7-8. Reading The Charts.

The primary use of each chart is given in an example and a green guideline is provided to help you follow the route through the chart. The use of a straight edge (ruler or page edge) and a hard fine point pencil is recommended to avoid cumulative errors. The majority of the charts provide a standard pattern for use as follows: enter first variable on top left scale, move right to the second variable, deflect down at right angles to the third variable, deflect left at right angles to the fourth variable deflect down, etc. until the final variable is read out at the final scale. In addition to the primary use, other uses of the chart are explained in the text accompanying each set of performance charts. Colored registration blocks located on the bottom and top of each chart are used to determine if slippage has occured during printing. If slippage has occured, refer to chapter 5 for correct operating limits.

7-9. Data Basis.

The type of data used is indicated at the bottom of each performance chart under DATA BASIS. The data provided generally is based on one of three categories:

a. Flight Test Data. Data obtained by flight test of the aircraft by experienced flight test personnel at precise conditions using sensitive calibrated instruments.

b. Calculated Data.

Data based on tests, but not on flight test of the complete aircraft.

c. Estimated Data. Data based on estimates using aerodynamic theory or other means but not verified by flight test.

7-10. Specific Conditions.

The data presented is accurate only for specific conditions listed under the title of each chart. Variables for which data is not presented but which may affect that phase of performance, are discussed in the test. Where data is available or reasonable estimates can be made, the amount that each variable affects performance will be given.

7-11. General Conditions.

The following general conditions might have deteriorating effects on the aircraft performance: atmospheric humidity, fuel flow, rigging, pilot technique, aircraft variation, engine variation, and instrument variation.

7-12. Performance Discrepancies.

Regular use of this chapter will allow you to monitor instrument and other aircraft systems for malfunction, by comparing actual performance with planned performance. Knowledge will also be gained concerning the effects of variables for which data is not provided, thereby increasing the accuracy of performance predictions.

SECTION II. PERFORMANCE PLANNING

7-13. Performance Planning Card (PPC).

This card (fig. 7-1) is provided to assist the pilot in recording data applicable to the mission and may be reproduced at the local level. This does not preclude the use of locally developed cards. The PPC provides readily available information for departure, climb, cruise, arrival and prevailing conditions. Pertinent data required to fill in the blanks on the PPC shall be computed from the performance charts and tables contained in this chapter, and from existing conditions at time of takeoff or landing. The takeoff and landing data shall be computed prior to takeoff, as a precaution against emergency conditions which could develop after takeoff. The following blocks are provided on the front of the PPC for entry of data as applicable:

a. Weather Data.

(1) PA (pressure altitude).

(2) FAT (free air temperature.

(3) WIND (speed and direction).

(4) RWY (runway heading, length and slope).

b. Aircraft Data.

(1) T/O WT (takeoff weight).

(2) LDG WT (landing weight).

c. Performance Data.

(1) T/O PWR (torque).

(2) T/O RUN (no obstacle or obstacle clearance (if required).

(3) ACC-STOP (accelerate-stop distance).

(4) V_{mc} (minimum single engine control airspeed).

(5) V_r-V_{lof} (rotation airspeed and liftoff airspeed).

(6) V_x-V_y (best angle-of-climb and best rate-of-climb).

(7) V_{yse} (single engine best rate-of-climb).

(8) V_{ref} (landing speed).

(9) LDG RUN.

(10) Additional data as required.

7-14. Performance Planning Sequence.

The following information may be extracted from the charts in this chapter.

NOTE

The pressure altitude may be determined by setting the altimeter to 29.92 and reading the pressure altitude, or by adding 100 feet to the field elevation for each 0.1 in. Hg. below 29.92, or by subtracting 100 feet from the field elevation for each 0.1 in. Hg. above 29.92.

a. Preflight Planning.

(1) Determine the following conditions for each phase of the flight, as appropriate, before entering the performance charts and enter the information on the PPC.

(a) Pressure altitude.

(b) Free air temperature.

(c) Wind.

(d) Aircraft weight (both takeoff and landing).

NOTE

Weight and balance blocks are provided on the rear of the PPC and should be utilized to determine exact weight and loading conditions prior to computing takeoff and landing data. Weight information may be obtained from either Chart C or the current Form 365F.

(e) Obstacles (if applicable).

(f) Ceiling and visibility.

(g) Instrument departure and approach procedures.

(h) Hazards.

(2) Determine the following conditions from the performance charts and enter the information on the PPC blocks provided.

(a) T/O PWR - Takeoff power. Obtain from TORQUE AVAILABLE FOR TAKEOFF chart.

(b) T/O RUN - Take off distance. Obtain from TAKEOFF-NORMAL chart.

(c) ACC-STOP - Accelerate-stop distance. Obtain from ACCELERATE-STOP DISTANCE chart. An ACCELERATE-CHECK chart is provided for optional use during critical length takeoffs.

(d) V_{mc} - Minimum single engine control airspeed. Obtain from MINIMUM SINGLE ENGINE CONTROL AIRSPEED (V_{mc}) chart.

(e) V_r-V_{lof} - Rotation airspeed and liftoff airspeed. Obtain from NORMAL ROTATION/TAKEOFF AIRSPEED chart.

NOTE

For the purposes of this manual V_x will be approximated by the Obstacle Clearance Climb airspeed obtained using the Normal Rotation/ Takeoff Airspeed Chart.

(f) V_x-V_y - Best angle-of-climb airspeed and best rate-of-climb airspeed. Obtain estimated V_x from NORMAL ROTATION/TAKEOFF AIRSPEED chart (obstacle clearance airspeed). Obtain V_y from the MAX R/C LINE (two engine) using the appropriate CRUISE chart.

(g) V_{yse} - Best single engine rate-of-climb. Obtain from from appropriate CRUISE chart.

FW PERFORMANCE PLANNING (PPC)

TCs 1-144/1-145

PA	FAT
RWY	WIND
T/O WT	LDG WT

T/O PWR	
T/O RUN	
ACC-STOP	
V_{mc}	
V_r-V_{lof}	/
V_x-V_y	/
V_{yse}	
V_{ref}	
LDG RUN	

Figure 7-1. Performance Planning Card (sheet 1 of 2)

THIS SIDE OPTIONAL DATA

WT COMPUTATION

BASIC WT (OIL INCL)	
CREW & FLT EQUIP	
EMER OR OTHER EQUIP	
OPERATING WT	
FUEL WT	
PAX-BAGGAGE-CARGO	
TAKEOFF WT (MINUS R/U FUEL)	

CRUISE DATA

PA FAT WIND

WT PWR

KIAS KTAS

FUEL RATE SE CEILING

BLOCK SPEED & FUEL REQUIRED

ITEM	TIME	FUEL	DIST
R/U-T/O			
CLIMB			
CRUISE			
DESCENT			
APPROACH			
TOTAL			

LANDING DATA

INST APP RWY WIND

CEIL VIS ALT TEMP

WT V_{ref} LDG RUN

AP 004689.2

Figure 7-1. Performance Planning Card (sheet 2 of 2)

TEMPERATURE CONVERSION/CORRECTION

TEMPERATURE CONVERSION /CORRECTION
U-21A
T74-CP-700

EXAMPLE

WANTED

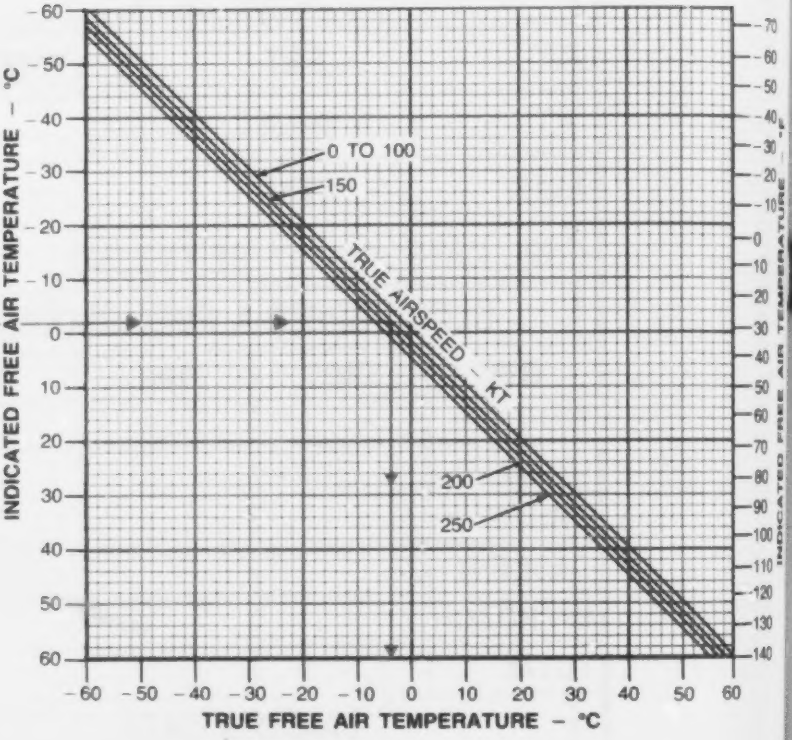
TRUE FAT

KNOWN

INDICATED FAT = -2°C
TRUE AIRSPEED = 154 KT

METHOD

ENTER INDICATED FAT HERE
MOVE RIGHT TO TRUE AIRSPEED
MOVE DOWN READ TRUE
FAT = -4°C



G

AP 00150

Figure 7-2. Temperature Conversion Correction

(h) V_{ref} - Landing approach airspeed. Obtain from APPROACH SPEED chart. This airspeed shall be computed for landing immediately after takeoff in the event of an emergency.

(i) LDG RUN - Landing distance. Obtain from Landing chart. This distance shall be computed for landing immediately after takeoff in the event of an emergency.

(3) After the takeoff and landing data has been logged, evaluate the performance/risk trade-off of the following:

(a) Crosswind conditions.

(b) Takeoff, accelerate-stop and landing distances.

(c) Obstacle clearance in the event of engine failure.

b. Rear of PPC.

(1) Cruise data. Space is provided on the rear of the PPC for such information as pressure altitude (PA), free air temperature (FAT), wind speed and direction (WIND), aircraft weight (WT), power required (PWR), airspeed (KIAS and KCAS), fuel flow (FUEL RATE) and single engine ceiling (SE CEILING). Power, airspeed and fuel rate may be obtained from the Cruise charts. Single engine ceiling may be obtained from the Operation Envelope chart.

NOTE

BLOCK SPEED AND FUEL REQUIRED space is provided on the rear of the PPC for use as required. Performance charts are available for climb and cruise information. Descent information may be obtained by interpolating between Cruise charts and the Climb/Descent chart. The approach spaces may be utilized to compute total time/fuel/and distance to actual landing.

(2) Landing data. Space is provided on the rear of the PPC for entry of landing data. This information should be computed prior to landing and reflect actual landing weight so the landing approach speed (V_{ref}) and landing distance will be correct. The instrument approach in use and current weather conditions may also be entered.

7-15. Performance Information.

Performance information obtained may make it necessary to alter gross weight, airspeed, altitude, or other variables in order to safely operate the aircraft. If any of these variables are changed on one chart, corresponding changes will be necessary on all other charts where that information is used.

7-16. Airspeed Position Error Correction.

The relationship between indicated airspeed and calibrated airspeed for various flap settings is shown for the normal static air source.

NOTE

Indicated airspeed assumes a zero instrument error. also, no significant change in airspeed position correction is apparent due to power settings, altitude or landing gear position. All airspeed calibrations were conducted in level flight and may not be appropriate for stall.

7-17. Altimeter Position Error Correction.

The altitude corrections to be made to the altimeter reading are shown for various altitudes and flap positions for the normal static air source.

NOTE

Indicated altitude assumes a zero instrument error, also, no significant change in position error correction is apparent due to power settings or landing gear positions.

AIRSPEED CALIBRATION – NORMAL SYSTEM

AIRSPEED CALIBRATION
NORMAL SYSTEM
U-21A
T74-CP-700

EXAMPLE

WANTED

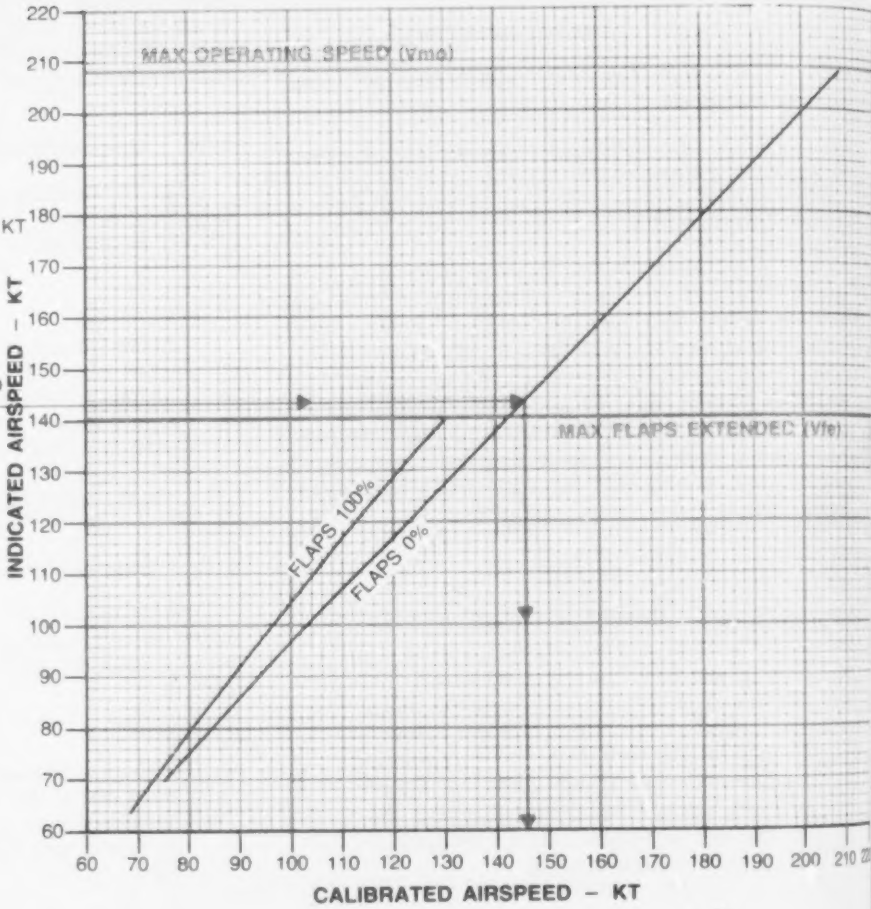
CALIBRATED AIRSPEED

KNOWN

INDICATED AIRSPEED = 143 KT
FLAP SETTING = 0%

METHOD

ENTER INDICATED AIRSPEED HERE
MOVE RIGHT TO FLAP SETTING
MOVE DOWN, READ CALIBRATED AIRSPEED = 145 KT



DATA BASIS: DERIVED FROM FLIGHT TEST

Figure 7-3. Airspeed Calibration - Normal System

AIRSPEED CALIBRATION – EMERGENCY SYSTEM

AIRSPEED CALIBRATION
EMERGENCY SYSTEM
U-21A
T74-CP-700

EXAMPLE

WANTED

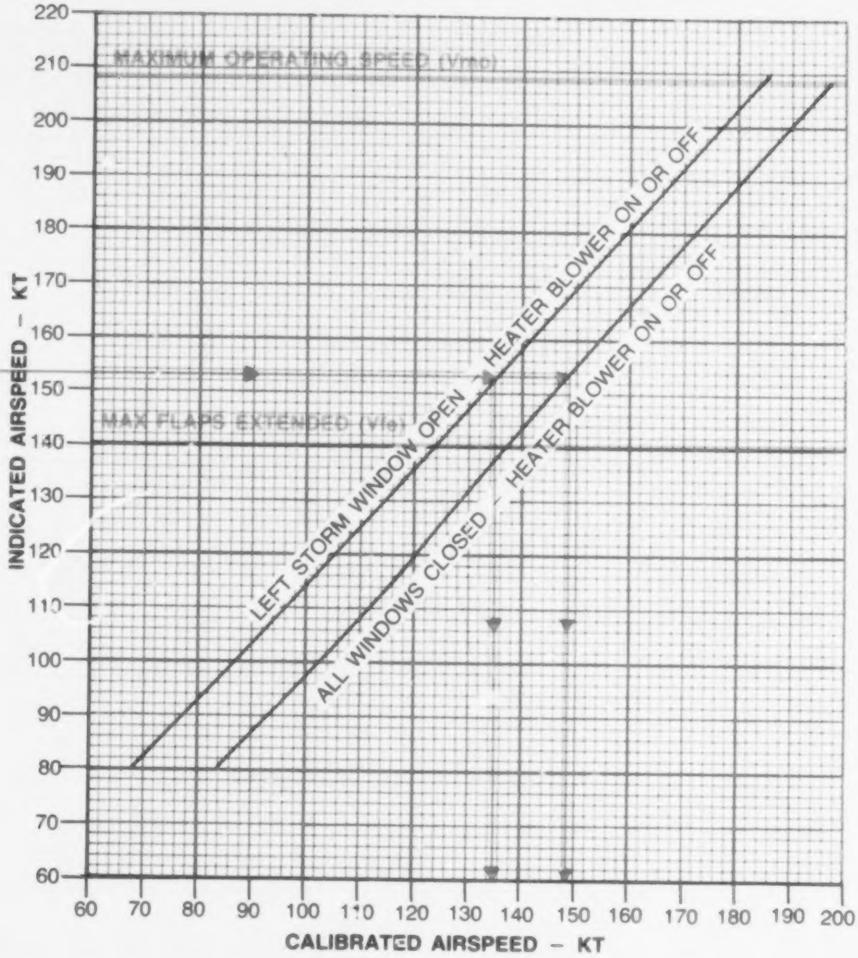
CALIBRATED AIRSPEED

KNOWN

INDICATED AIRSPEED = 153 KT
LEFT STORM WINDOW OPEN, OR, ALL WINDOWS CLOSED

METHOD

ENTER INDICATED AIRSPEED HERE
MOVE RIGHT TO STORM WINDOW OPEN
MOVE DOWN, READ CALIBRATED AIRSPEED = 135 KT
MOVE RIGHT TO ALL WINDOWS CLOSED
MOVE DOWN, READ CALIBRATED AIRSPEED = 149 KT



R ▢
G ▨

DATA BASIS: DERIVED FROM FLIGHT TEST

AP 000998

Figure 7-4. Airspeed Calibration - Emergency System

ALTIMETER CORRECTION – NORMAL SYSTEM

ALTIMETER CORRECTION
NORMAL SYSTEM
U-21A
T74-CP-700

EXAMPLE

WANTED

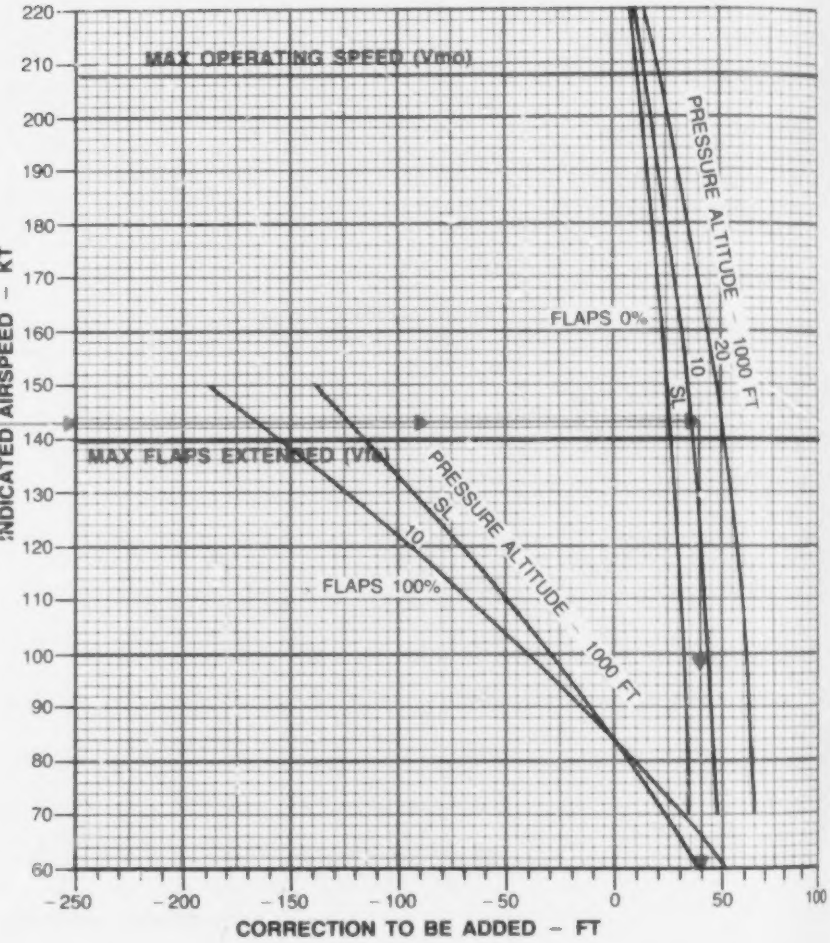
CORRECTED ALTITUDE

KNOWN

INDICATED ALTITUDE = 12,000 FT
INDICATED AIRSPEED = 143 KT
PRESSURE ALTITUDE = 12,000 FT
FLAPS SETTING = 0%

METHOD

ENTER INDICATED AIRSPEED HERE
MOVE RIGHT TO PRESSURE ALTITUDE FOR FLAP SETTING
MOVE DOWN, READ ALTITUDE CORRECTION = 40 FT CORRECTED ALTITUDE = (INDICATED ALTITUDE + CORRECTION) = 12,040 FT



DATA BASIS: DERIVED FROM FLIGHT TEST

AP 000997

Figure 7-5. Altimeter Correction - Normal System

ALTIMETER CORRECTION-EMERGENCY SYSTEM

**ALTIMETER CORRECTION
EMERGENCY SYSTEM
U-21A
T74-CP-700**

EXAMPLE

WANTED

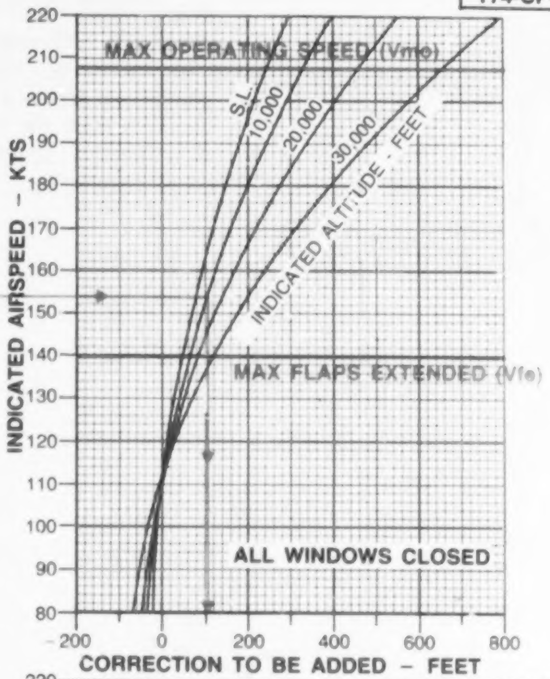
CORRECTED ALTIMETER CORRECTION

KNOWN

INDICATED ALTITUDE = 10,000 FT
INDICATED AIRSPEED = 153 KT
PRESSURE ALTITUDE = 12,000 FT
ALL WINDOWS CLOSED

METHOD

ENTER INDICATED AIRSPEED HERE
MOVE RIGHT TO PRESSURE ALTITUDE
MOVE DOWN, READ ALTITUDE
CORRECTION = 105 FT CORRECTED
ALTITUDE = (INDICATED +
CORRECTION) = 12,105 FT



DATA BASIS: FLIGHT TEST

WANTED

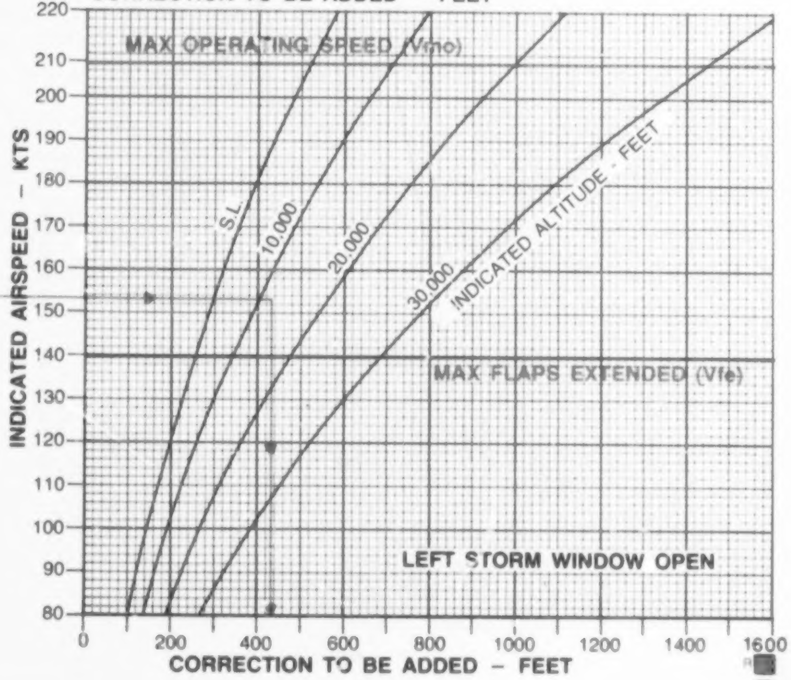
CORRECTED ALTIMETER CORRECTION

KNOWN

INDICATED ALTITUDE = 12,000 FT
INDICATED AIRSPEED = 153 KT
PRESSURE ALTITUDE = 12,000 FT
LEFT STORM WINDOW OPEN

METHOD

ENTER INDICATED AIRSPEED HERE
MOVE RIGHT TO PRESSURE ALTITUDE
MOVE DOWN READ ALTITUDE
CORRECTION = 430 FT
CORRECTED ALTITUDE = (INDICATED
+ CORRECTION) = 12,430 FT



DATA BASIS: FLIGHT TEST

AP 000999

Figure 7-6. Altimeter Correction - Emergency System

SECTION III. CROSSWIND - TAKEOFF OR LANDING

7-18. Description.

The Crosswind Chart (fig. 7-7) shows the crosswind conditions under which a takeoff or landing is not recommended.

7-19. Use of Chart.

Recommended rotation airspeed is obtained from the Normal Rotation/ Rotation/Takeoff Airspeed Chart (fig. 7-11). Takeoff should not be attempted when the rotation speed intercept point falls within the non-recommended area. Select a touchdown airspeed less than the approach airspeed obtained from the Approach Speed Chart (fig. 7-72) such that the touchdown airspeed falls within the recommended area.

CROSSWIND – TAKEOFF OR LANDING

CROSSWIND TAKEOFF
OR LANDING
U-21A
T74-CP-700

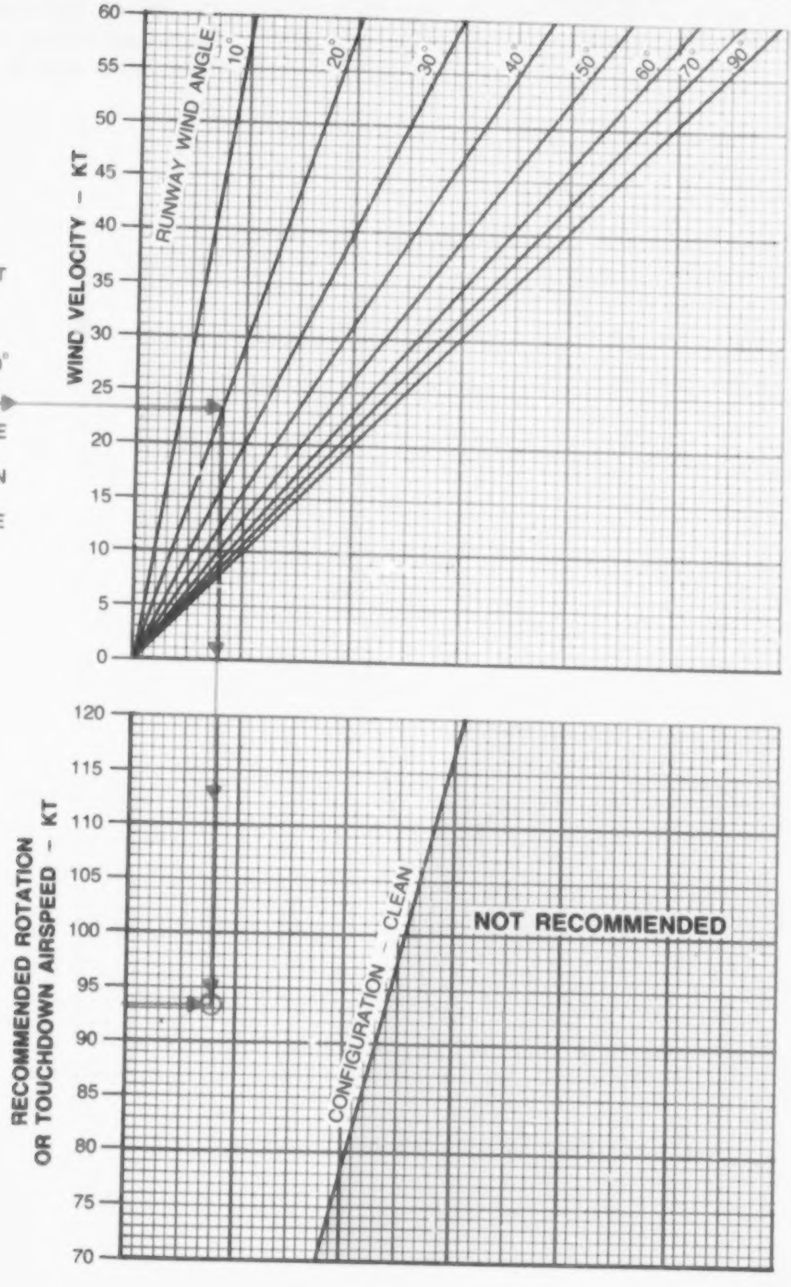
EXAMPLE

KNOWN

CLEAN CONFIGURATION
RUNWAY 21
WIND VELOCITY = 23 KT
WIND DIRECTION = 190°
NORMAL ROTATION AIRSPEED = 93 KT

METHOD

DETERMINE RUNWAY WIND ANGLE, 210° – 190° = 20°
ENTER WING VELOCITY HERE
MOVE RIGHT TO RUNWAY WIND ANGLE = 20°
MOVE DOWN TO NORMAL ROTATION AIRSPEED LINE = 93 KTS
THE INTERSECTION FALLS WITHIN THE RECOMMENDED AREA



DATA BASIS: FLIGHT TEST

AP 000960

Figure 7-7. Crosswind - Takeoff or Landing

SECTION IV. IDLE FUEL FLOW

7-20. Description

The Idle Fuel Flow Chart (fig. 7-8) shows idle fuel flow in pounds per hour at various altitudes and FAT.

7-21. Use of Chart.

NOTE

Fuel flow values should be doubled for two engine operation.

7-22. Conditions.

All fuel flow data is based on JP-4 aviation fuel. Variations in fuel temperature may change the fuel flow values slightly.

IDLE FUEL FLOW

JP-4 FUEL

IDLE FUEL FLOW
U-21A
T74-CP-700

EXAMPLE

WANTED

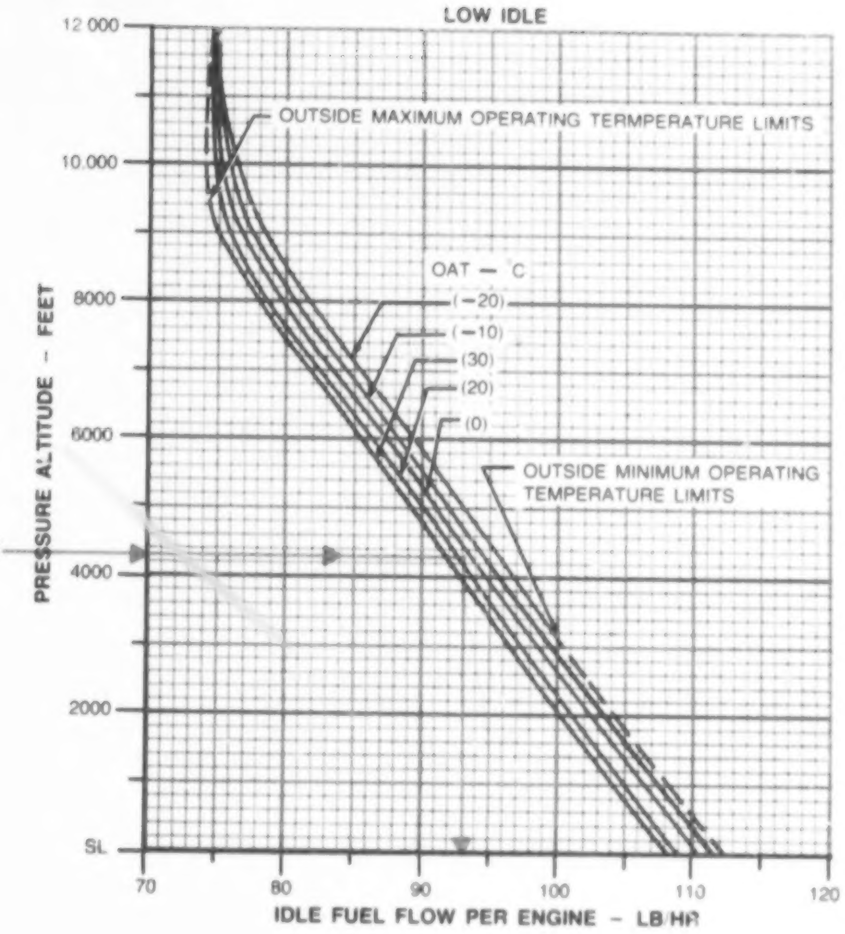
IDLE FUEL FLOW AT LOW IDLE

KNOWN

PRESSURE ALTITUDE = 4307 FT
FAT = 12°C

METHOD

ENTER PRESSURE ALTITUDE HERE
MOVE RIGHT TO FAT = 12°C
MOVE DOWN, READ IDLE FUEL
FLOW = 93 LB/HR



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AP 001000

Figure 7-8. Idle Fuel Flow.

SECTION V. TORQUE AVAILABLE FOR TAKEOFF

7-23. Description.

The Torque Available For Takeoff Chart (fig. 7-9) shows the torque in foot-pounds available for takeoff. The torque limits to observe for takeoff are also shown.

7-24. Use Of Chart.

Takeoff distances scheduled on the Takeoff-Normal Chart (fig. 7-10) are based on power set according to this chart.

7-25. Conditions.

a. Power levers - Advance to takeoff power.

b. Propeller speed - 2200 RPM.

TORQUE AVAILABLE FOR TAKEOFF
PROP SPEED = 2200 RPM
FUEL JP-4 AIRSPEED = 0 KNOTS

TORQUE AVAILABLE
FOR TAKEOFF
U-21A
T74-CP-700

EXAMPLE

WANTED

TORQUE AVAILABLE
FOR TAKEOFF

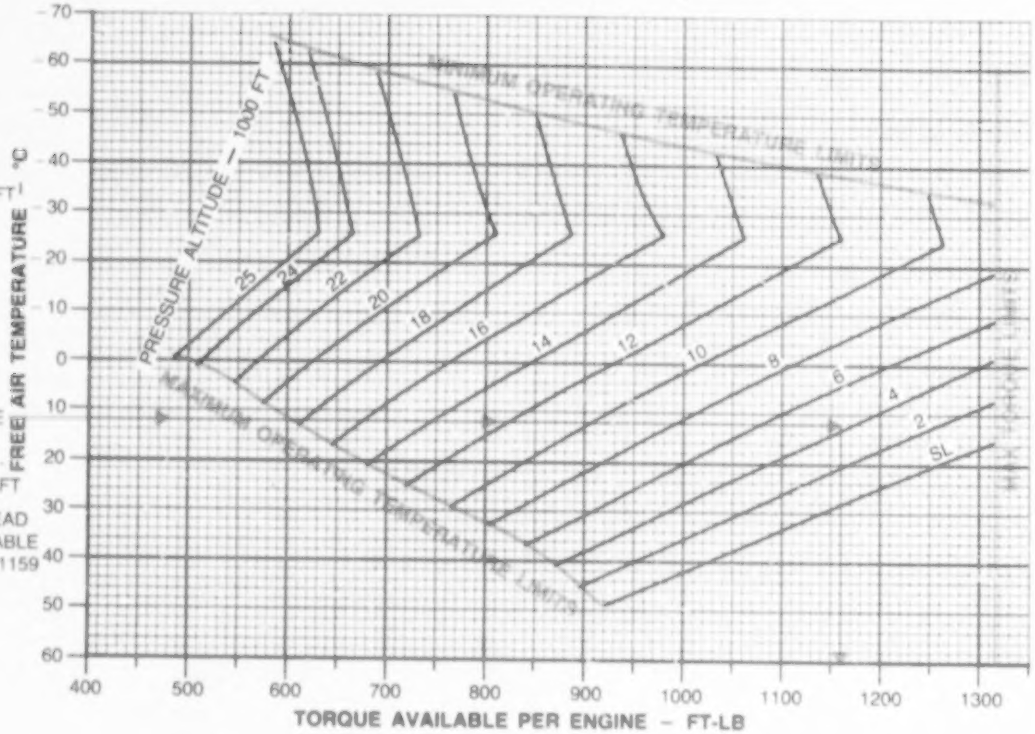
KNOWN

FAT = 12°C
PRESSURE ALT
ITUDE = 4307 FT

METHOD

ENTER FAT HERE
MOVE RIGHT TO
PRESSURE ALT-
ITUDE = 4307 FT

MOVE DOWN. READ
TORQUE AVAILABLE
PER ENGINE = 1159
FT-LB



NOTE

1. TORQUE INCREASES APPROXIMATELY 15 FT-LB FROM ZERO TO 70 KNOTS.
2. THIS CHART IS BASED ON AN ENGINE WITH MAXIMUM DETERIORATION OF EXCESS TORQUE WHICH CAN BE PERMITTED WITHOUT EXCEEDING ENGINE LIMITATIONS.
3. TAKE-OFF PERFORMANCE WAS DEVELOPED UTILIZING THE TORQUE VALUES SHOWN

DATA BASIS: CALCULATED FROM ENGINE MODEL SPEC.

AP 001538

Figure 7-9. Torque Available for Takeoff

SECTION VI. NORMAL TAKEOFF

7-26. Description.

The Takeoff-Normal Chart (fig. 7-10), shows the ground roll distance and the total distance required to clear varying obstacle heights at a known free air temperature, pressure altitude and weight.

7-27. Use of Chart.

In order to achieve these distances, airspeeds obtained from the Normal Rotation/Takeoff Airspeed Chart (fig. 7-11), and power set according to the Torque Available for Takeoff Chart (fig. 7-9), shall be used.

7-28. Conditions.

a. Engine - Both engines operating with takeoff power and 2200 RPM with torque set according to the Torque Available for Takeoff Chart (fig. 7-9).

b. Flaps - UP.

c. Landing gear - UP (after liftoff).

d. Technique - Apply maximum allowable takeoff power and accelerate on the runway. Takeoff power must be applied prior to releasing brakes to obtain the normal takeoff distances in chapter 7. Rotate at recommended rotation speed (V_r), establish a pitch attitude that allows liftoff at recommended liftoff speed (V_{lof}). When flight is assured, retract the gear and establish proper initial climb attitude (obstacle clearance climb speed V_x) or (best rate of climb speed V_y) dependent on existing conditions.

e. Wind - All data presented are based on calm wind conditions. Since surface windspeed and direction can not be accurately predicted, all takeoffs shall be planned based on calm wind. Distance decreases approximately 1% per knot headwind. Distance increases approximately 3% per knot tailwind.

f. Runway - Runway conditions for this chart are based on a dry, hard-surface, level runway. Conditions other than these will vary aircraft takeoff distances. Ground roll distance decreases approximately 5% per 1% downhill gradient. Ground roll distance increases approximately 7% per 1% uphill gradient.

NOTE

Refer to the Single-Engine Climb Chart (fig. 7-15), to determine if adequate performance is available in the event of engine failure during takeoff.

TAKEOFF – NORMAL

CALM WINDS FLAPS 0 PERCENT POWER – TAKEOFF
LEVEL HARD SURFACE

TAKEOFF NORMAL
U-21A
T74-CP-700

EXAMPLE

WANTED

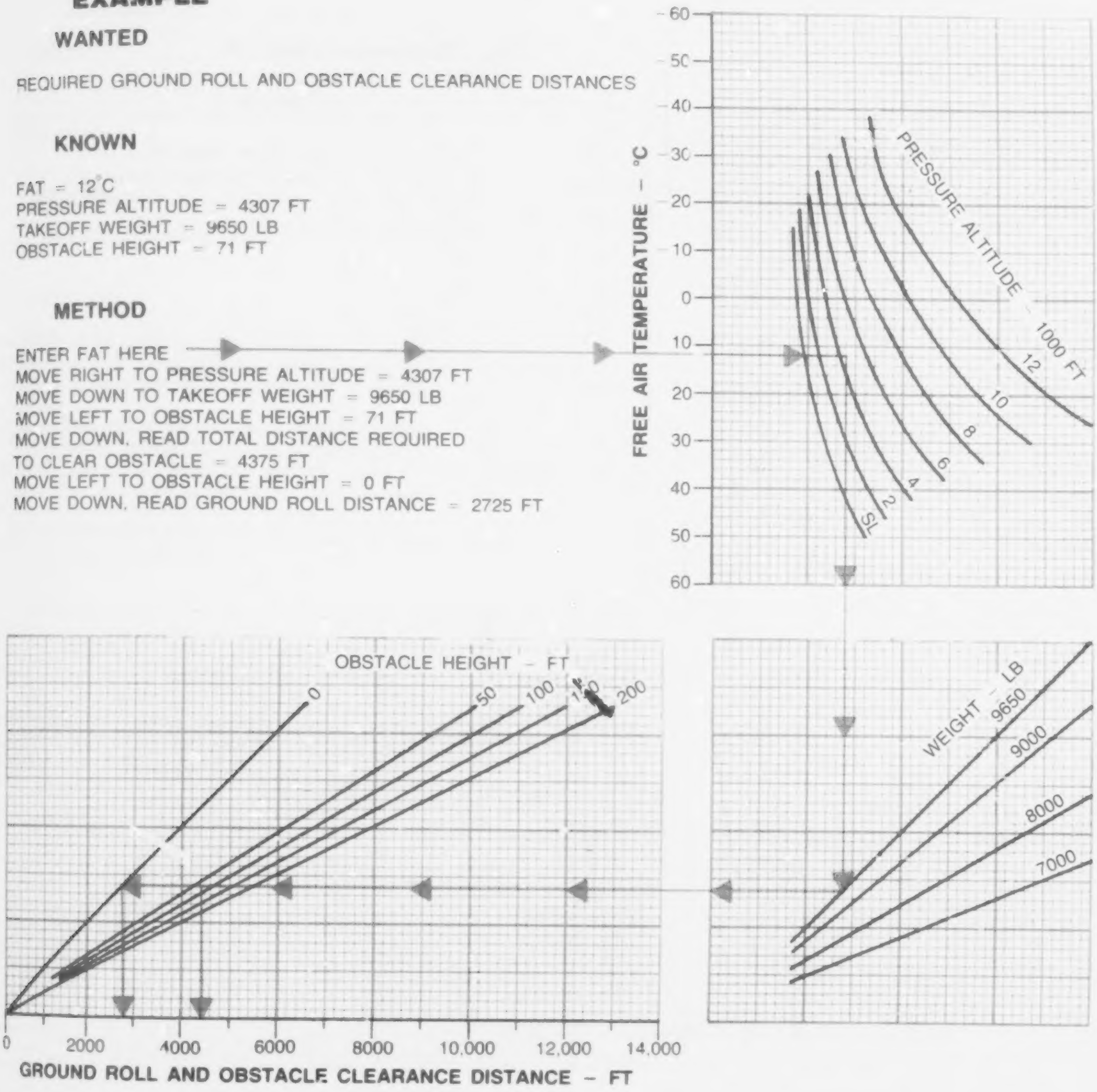
REQUIRED GROUND ROLL AND OBSTACLE CLEARANCE DISTANCES

KNOWN

FAT = 12°C
PRESSURE ALTITUDE = 4307 FT
TAKEOFF WEIGHT = 9650 LB
OBSTACLE HEIGHT = 71 FT

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE = 4307 FT
MOVE DOWN TO TAKEOFF WEIGHT = 9650 LB
MOVE LEFT TO OBSTACLE HEIGHT = 71 FT
MOVE DOWN, READ TOTAL DISTANCE REQUIRED
TO CLEAR OBSTACLE = 4375 FT
MOVE LEFT TO OBSTACLE HEIGHT = 0 FT
MOVE DOWN, READ GROUND ROLL DISTANCE = 2725 FT



AP 000963

DATA BASIS: CALCULATED

Figure 7-10. Takeoff-Normal

SECTION VII. NORMAL ROTATION/TAKEOFF AIRSPEED

7-29. Description.

The Normal Rotation/Takeoff Airspeed Chart (fig. 7-11), shows rotation, takeoff, and obstacle clearance airspeeds for a known weight.

7-30. Use of Chart.

The rotation airspeed line shows recommended rotation indicated airspeed for a given weight. The takeoff airspeed line shows recommended takeoff indicated airspeed for a given weight. The obstacle clearance airspeed line shows the recommended indicated airspeed for a given weight to use for clearance of obstacles during the initial during the initial climb. Performance scheduled on the Takeoff-Normal Chart, (7-10), is based on use of these speeds.

7-31. Conditions - Flaps UP.

NOTE

These speeds have been selected in order to provide adequate margins above the flaps up stall speed and single-engine minimum control airspeed (V_{mc}).

NORMAL ROTATION/TAKEOFF AIRSPEED

FLAPS 0 PERCENT

NORMAL ROTATION/
TAKEOFF AIRSPEED
U-21A
T74-CP-700

EXAMPLE

WANTED

NORMAL ROTATION, TAKEOFF, AND OBSTACLE CLEARANCE AIRSPEEDS FOR KNOWN TAKEOFF WEIGHT

KNOWN

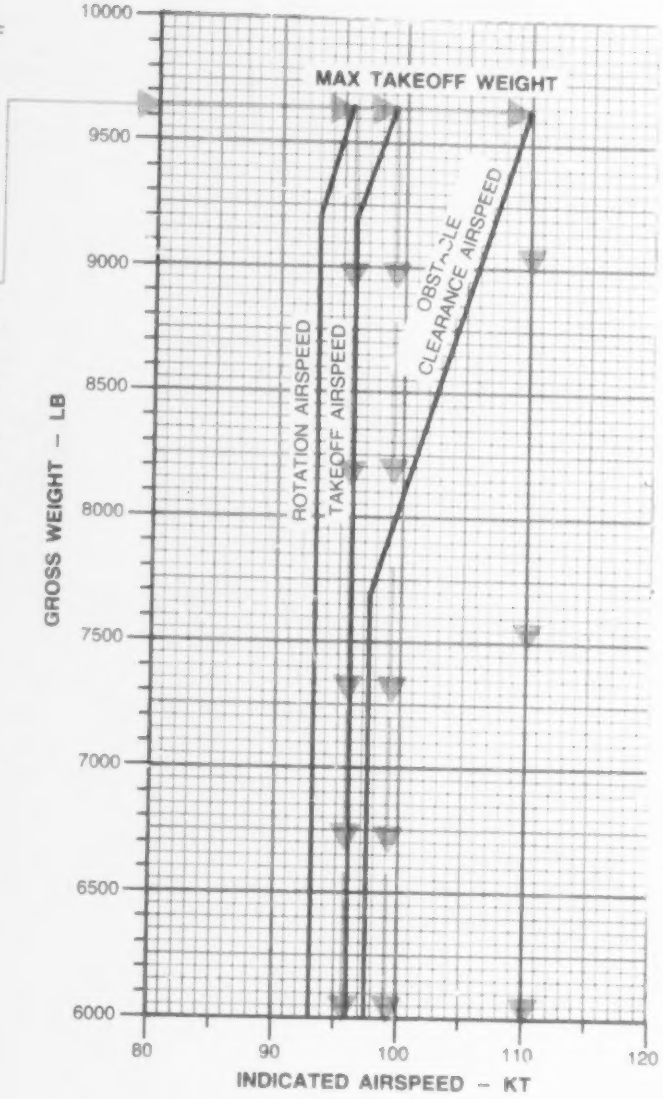
TAKEOFF WEIGHT = 9650 LB

METHOD

ENTER TAKEOFF WEIGHT HERE
MOVE RIGHT TO ROTATION AIRSPEED, TAKEOFF AIRSPEED AND OBSTACLE CLEARANCE AIRSPEED LINES
MOVE DOWN FROM ROTATION AIRSPEED LINE, READ INDICATED AIRSPEED FOR ROTATION 96 KT
MOVE DOWN FROM TAKEOFF AIRSPEED LINE, READ INDICATED AIRSPEED FOR TAKEOFF 99 KT
MOVE DOWN FROM OBSTACLE CLEARANCE AIRSPEED LINE, READ INDICATED AIRSPEED FOR OBSTACLE CLEARANCE 110 KT

NOTE

OBSTACLE CLEARANCE AIRSPEED LINE ALSO INDICATES THE BEST TWO ENGINE AND SINGLE-ENGINE ANGLE OF CLIMB SPEEDS.



DATA BASIS: FLIGHT TEST

AP 000984

Figure 7-11. Normal Rotation/Takeoff Airspeed

SECTION VIII. ACCELERATION CHECK

7-32. Description.

The Acceleration Check chart (fig. 7-12), shows the relationship between indicated airspeed and ground roll distance during the takeoff run.

7-33. Use of Chart.

Required airspeeds at designated points along the runway are obtained from this chart. This chart is used in conjunction with the ground roll distance from the Takeoff-Normal Chart (fig. 7-10), and the takeoff airspeed from the Normal Rotation/Takeoff Airspeed chart (fig. 7-11). If required indicated airspeed is not obtained at a selected distance and the runway length is critical, the takeoff should be aborted.

7-34. Conditions.

a. Engines - Both engines operating with takeoff power and 2200 RPM according to Torque Available for Takeoff Chart (fig. 7-9).

b. Flaps - UP.

c. Landing Gear - DN.

d. Technique - Apply takeoff power and accelerate on the runway. When the aircraft passes an acceleration check point, insure that the required airspeed has been achieved.

e. Runway - This chart is based on a dry, hard surface runway. Conditions other than this may vary aircraft operation. Adjust ground roll distance for runway gradient before entering this chart. Refer to Takeoff-Normal chart (fig. 7-10).

f. Wind - All data presented is based on calm wind conditions. Since surface wind conditions cannot be accurately predicted, all takeoffs shall be planned based on calm wind.

NOTE

This chart should always be entered with the takeoff airspeed appropriate to the weight

g. Acceleration Check - Is the distance from start of takeoff ground roll to an acceleration check point (runway distance marker, etc.)

ACCELERATION CHECK

POWER – TAKEOFF CALM WINDS
FLAPS 0 PERCENT LEVEL HARD SURFACE

ACCELERATION
CHECK
U-21A
T74-CP-700

EXAMPLE

WANTED

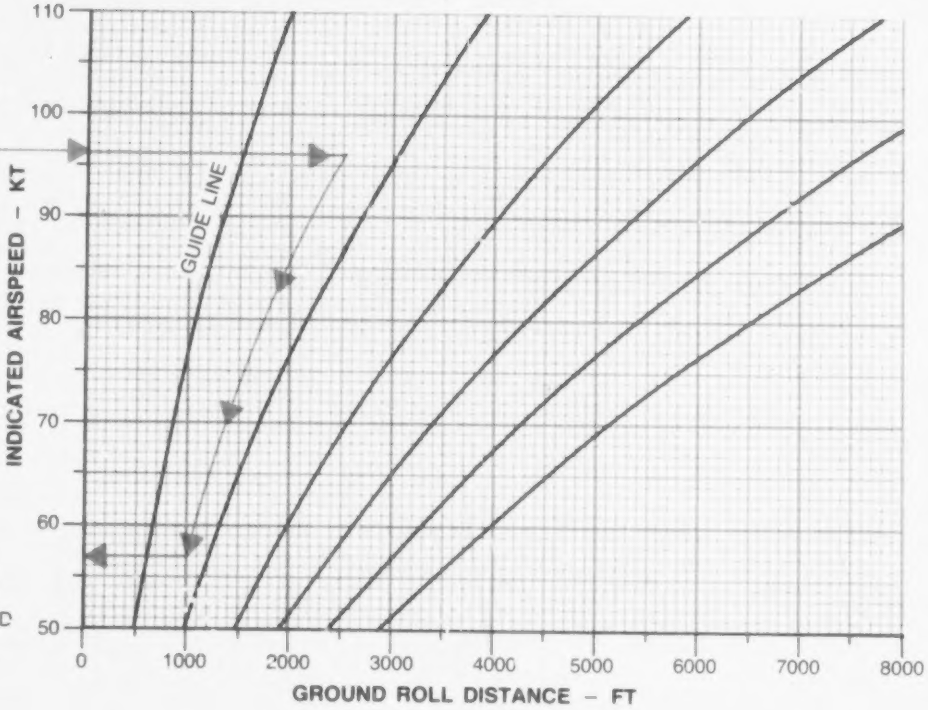
AIRSPEED REQUIRED AT VARIOUS ACCELERATION CHECK POINTS

KNOWN

TAKEOFF AIRSPEED FOR KNOWN GROSS WEIGHT OF 9,650 LB = 96 KT
GROUND ROLL DISTANCE = 2500 FT

METHOD

ENTER INDICATED AIR SPEED HERE
MOVE RIGHT TO GROUND ROLL DISTANCE LINE = 2500 FT
MOVE DOWN THE GUIDE LINE TO THE 1000 FT GROUND ROLL DISTANCE LINE
MOVE LEFT, READ INDICATED AIRSPEED REQUIRED AT 1000 FT MARKER = 57 KT



DATA BASIS: ESTIMATED

AP 001539

Figure 7-12. Acceleration Check

SECTION IX. ACCELERATE - STOP DISTANCE

7-35. Description.

The Accelerate Stop Distance Chart (fig. 7-13) shows the distance required to accelerate to takeoff airspeed then stop, at a known free air temperature, pressure altitude, and weight.

7-36. Use of Chart.

In order to achieve these distances, takeoff airspeeds obtained from the Normal Rotation/Takeoff Airspeed Chart (fig. 7-11), and power set according to the Torque Available for Takeoff Chart (fig. 7-9), shall be assumed.

7-37. Conditions.

a. Engines - Both engines operating with takeoff power and 2200 RPM with torque set according to the Torque Available for Takeoff Chart (fig. 7-9).

b. Flaps - Up.

c. Technique - Apply takeoff power prior to releasing brakes. Should engine failure occur at or before reaching takeoff airspeed, place both power levers in the idle position and apply maximum braking.

d. Wind - All data presented are based on calm wind conditions. Since surface wind speed and direction can not be accurately predicted, all takeoffs shall be planned based on calm wind. Accelerate-stop distance decreases approximately 1% per knot headwind and increases approximately 3% per knot tailwind.

e. Runway- Runway conditions for this chart are based on a dry, hard surface, level runway. Conditions other than these will vary aircraft accelerate-stop distance. Accelerate-stop distances increase approximately 4% per 1% downhull gradient. Accelerate-stop distances decrease approximately 3% per 1% uphill gradient.

ACCELERATE-STOP DISTANCE

HARD SURFACE RUNWAY WIND CALM FLAPS ZERO PERCENT
TAKEOFF POWER FOLLOWED BY IDLE POWER AND MAX BRAKING

ACCELERATE-STOP DISTANCE
U-21A
T74-CP-700

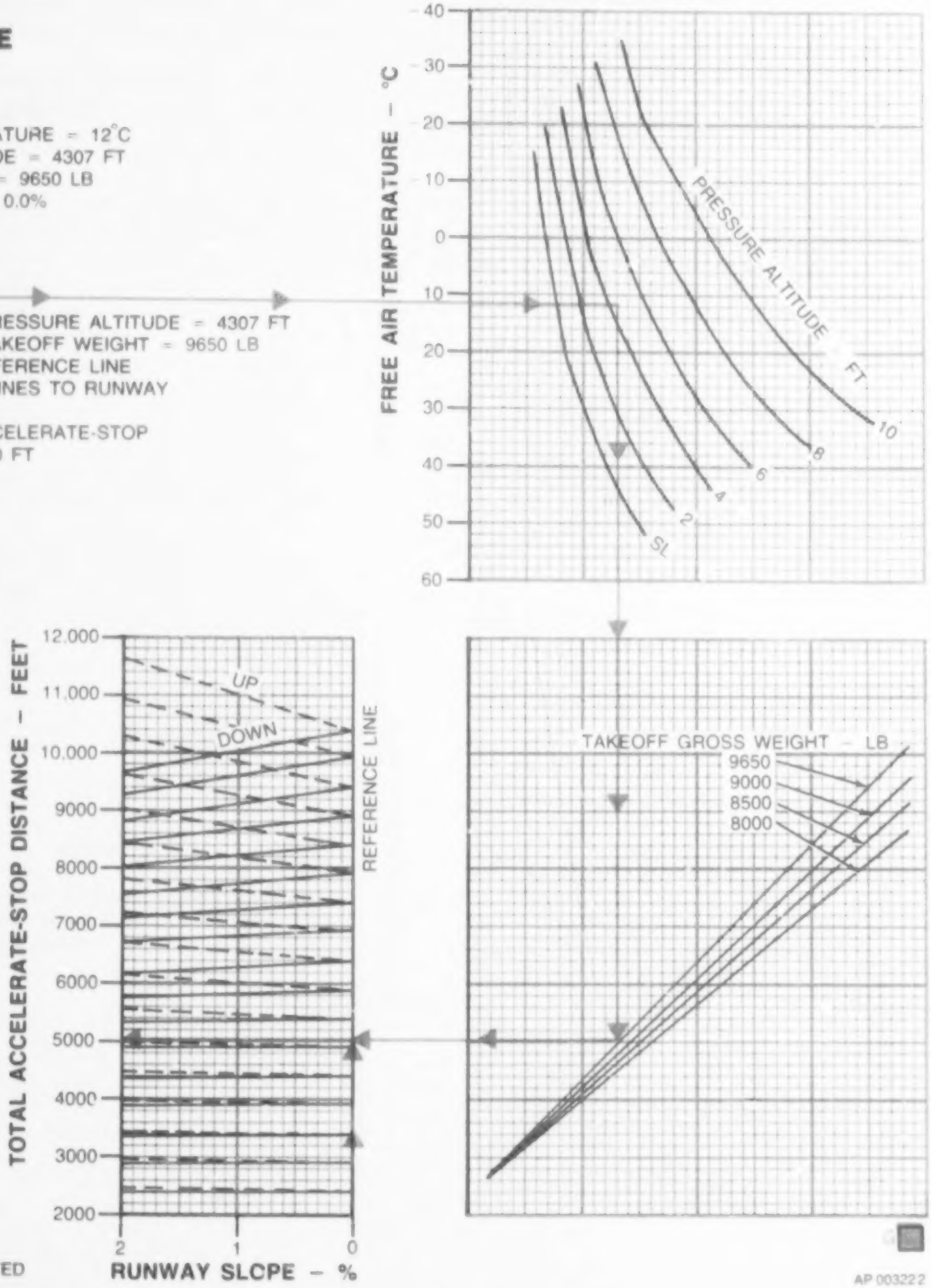
EXAMPLE

KNOWN

FREE AIR TEMPERATURE = 12°C
PRESSURE ALTITUDE = 4307 FT
TAKEOFF WEIGHT = 9650 LB
RUNWAY SLOPE = 0.0%

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE = 4307 FT
MOVE DOWN TO TAKEOFF WEIGHT = 9650 LB
MOVE LEFT TO REFERENCE LINE
FOLLOW GUIDE LINES TO RUNWAY SLOPE = 0%
MOVE LEFT TO ACCELERATE-STOP DISTANCE = 5000 FT



DATA BASIS: ESTIMATED

AP 003222

Figure 7-13. Accelerate-Stop Distance

SECTION X. MINIMUM SINGLE-ENGINE CONTROL AIRSPEED

7-38. Description.

The Minimum Single-Engine Control Airspeed Chart (fig. 7-14), shows the minimum airspeed (V_{mc}) which will allow aircraft directional control during single-engine operation for various air temperatures and altitudes. Directional control of the aircraft cannot be maintained for speeds below the rudder limit line with the non critical engine operating at takeoff power.

7-39. Use of Chart.

Flight at V_{mc} implies aircraft directional control only and does not provide the pilot with single-engine rate-of-climb information.

7-40. Conditions.

(a) Operating Engine - Operate with take-off power and 2200 RPM according to the Torque Available for Takeoff Chart (fig. 7-9).

(b) Inoperative Engine - Propeller FEATHER.

(c) Flaps - UP.

(d) Landing gear - DN.

MINIMUM SINGLE ENGINE CONTROL AIRSPEED (Vmc)

POWER – TAKEOFF GEAR DOWN
FLAPS 0 PERCENT PROP FEATHERED

MINIMUM SINGLE ENGINE
CONTROL AIRSPEED
U-21A
T74-CP-700

EXAMPLE

WANTED

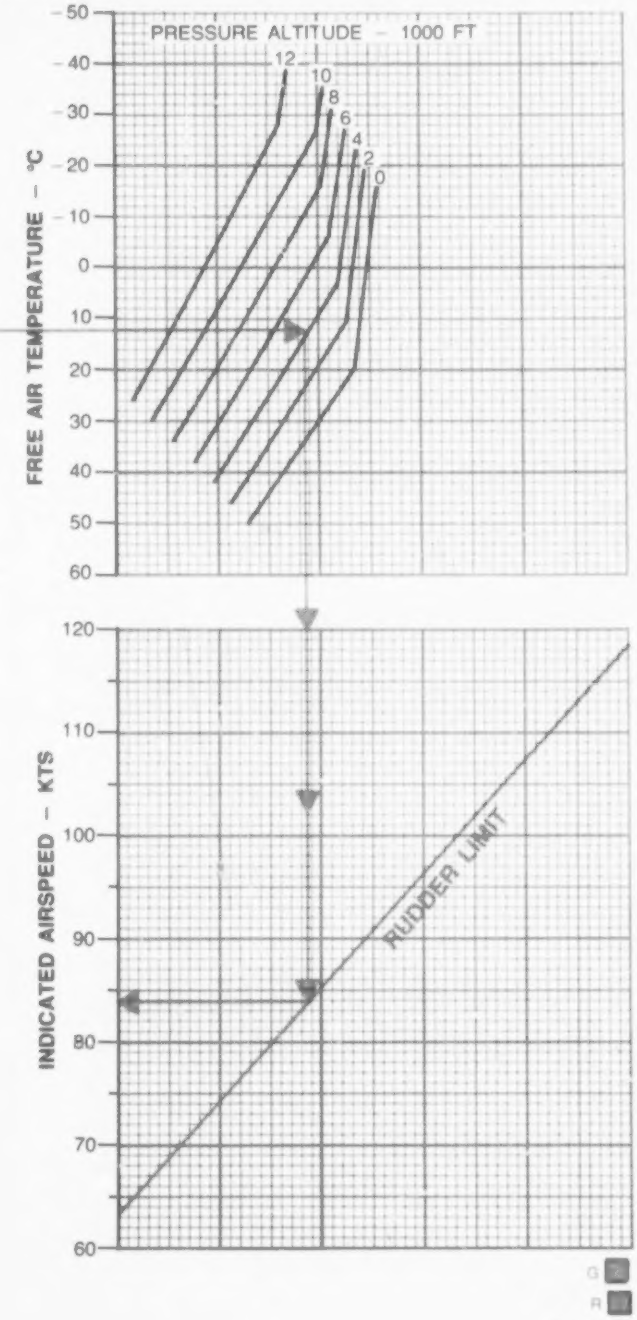
MINIMUM SINGLE ENGINE CONTROL AIRSPEED AT A GIVEN FAT AND PRESSURE ALTITUDE

KNOWN

FAT = 12°C
PRESSURE ALTITUDE = 4307 FT

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE = 4307 FT
MOVE DOWN TO RUDDER LIMITED LINE
MOVE LEFT, READ MINIMUM CONTROL INDICATED AIRSPEED = 84 KNOTS



NOTE

AT SOME WEIGHTS A STALL CONDITION CAN OCCUR AT AIRSPEEDS HIGHER THAN THE RUDDER LIMITED Vmc

DATA BASIS: FLIGHT TEST

Figure 7-14. Minimum Single-Engine Control Airspeed

SECTION XI. SINGLE-ENGINE CLIMB

7-41. Description. The Single-Engine Climb Chart (fig. 7-15), shows the critical engine inoperative takeoff rate-of-climb for varying air temperatures, altitudes, and weights for the gear down and gear up configurations. For single engine cruise information refer to the Cruise Charts (fig. 7-18 thru fig. 7-70), and for V_{mc} refer to the Minimum Single Engine Control Speed Chart (fig. 7-14).

7-42. Use of Chart.

This chart is to be used to determine single-engine performance in the event of engine failure during the takeoff and initial climb segements. Either weight for a desired rate-of-climb, or rate-of-climb for a known weight can be determined. Performance within the red zone(s) indicates the lack of positive climb capability.

7-43. Conditions.

a. Operating Engine - Operate at takeoff power and 2200 RPM according to the Torque Available for Takeoff Chart (fig. 7-9).

b. Inoperative Engine - Propeller FEATHER.

c. Flaps - UP.

d. Landing gear - UP (after liftoff).

e. Technique - Achieve and maintain the obstacle clearance airspeed appropriate to the weight. Refer to Normal Rotation/Takeoff Airspeed Chart (fig. 7-11).

NOTE

Refer to Normal Rotation/Takeoff Airspeed Chart (fig. 7-11). Gear down rates of climb are based on climb at the scheduled takeoff airspeed. Gear up rates of climb are based on climb at the scheduled obstacle clearance airspeed.

SINGLE ENGINE CLIMB

TAKE OFF CONFIGURATION

FLAPS 0 PERCENT PROP FEATHERED POWER — TAKEOFF

SINGLE-ENGINE
CLIMB
U-21A
T74-CP-700

EXAMPLE

WANTED

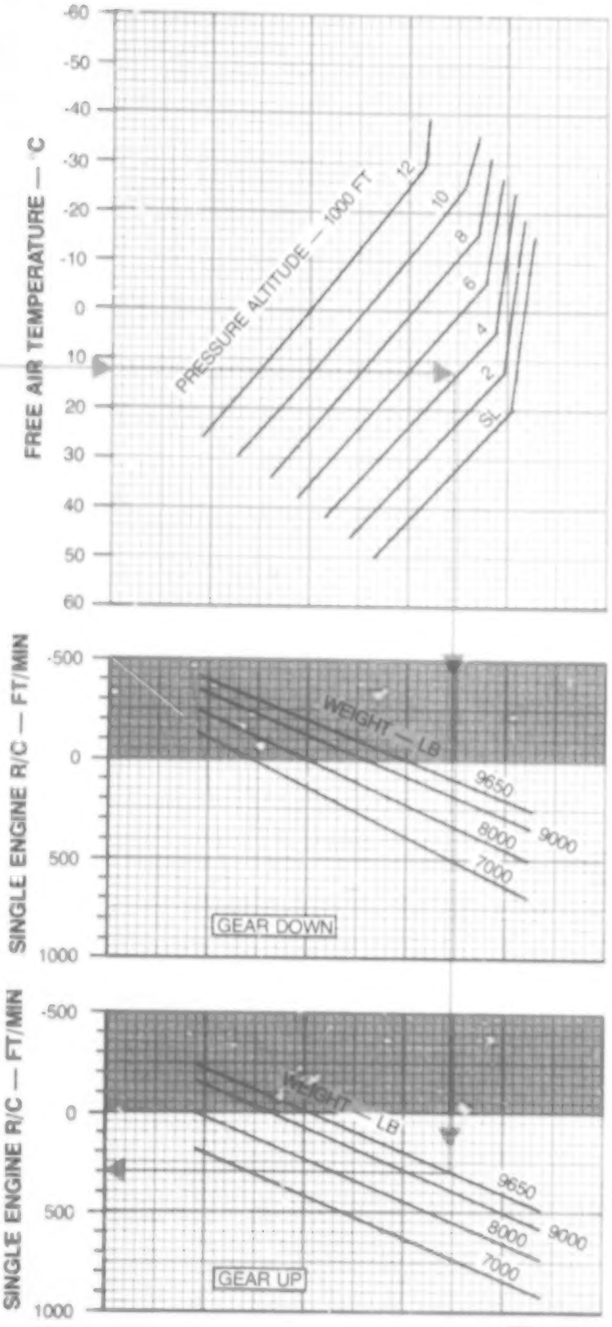
WEIGHT TO OBTAIN A POSITIVE SINGLE ENGINE R/C AT LIFTOFF AND SINGLE ENGINE R/C AFTER GEAR IS RETRACTED

KNOWN

FAT = 12°C
PRESSURE ALTITUDE = 4307 FT

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE = 4307 FT
MOVE DOWN TO 0 FT/MIN R/C FOR GEAR DOWN
READ WEIGHT TO OBTAIN POSITIVE R/C AT LIFTOFF = 9650 LBS. THE MAXIMUM TAKEOFF WEIGHT
MOVE DOWN TO WEIGHT = 9650 LBS FOR GEAR UP CLIMB
MOVE LEFT, READ SINGLE ENGINE R/C AFTER GEAR RETRACTION = 280 FT/MIN



DATA BASIS: FLIGHT TEST

Figure 7-15. Single-Engine Climb

SECTION XII. OPERATION ENVELOPE

7-44. Description.

The Operation Envelope Chart (fig. 7-16), shows the maximum temperatures for which operation is permitted; the minimum temperatures for which operation is recommended; the maximum altitudes possible for both two and single-engine operations; and identifies the altitude and temperature combinations for which Cruise Charts are available.

7-45. Use of Chart.

This chart is used to determine if the proposed flight is within the operational temperature/altitude envelope and to identify the temperature and altitude combinations which should be used for flight planning.

7-46. Conditions.

Service ceilings are based on the aircraft in a clean configuration.

OPERATION ENVELOPE

OPERATION ENVELOPE
U-21A
T74-CP-700

EXAMPLE

WANTED

DETERMINE IF FLIGHT IS WITHIN THE OPERATION ENVELOPE
DETERMINE THE CRUISE CHARTS TO USE FOR PERFORMANCE PLANNING

KNOWN

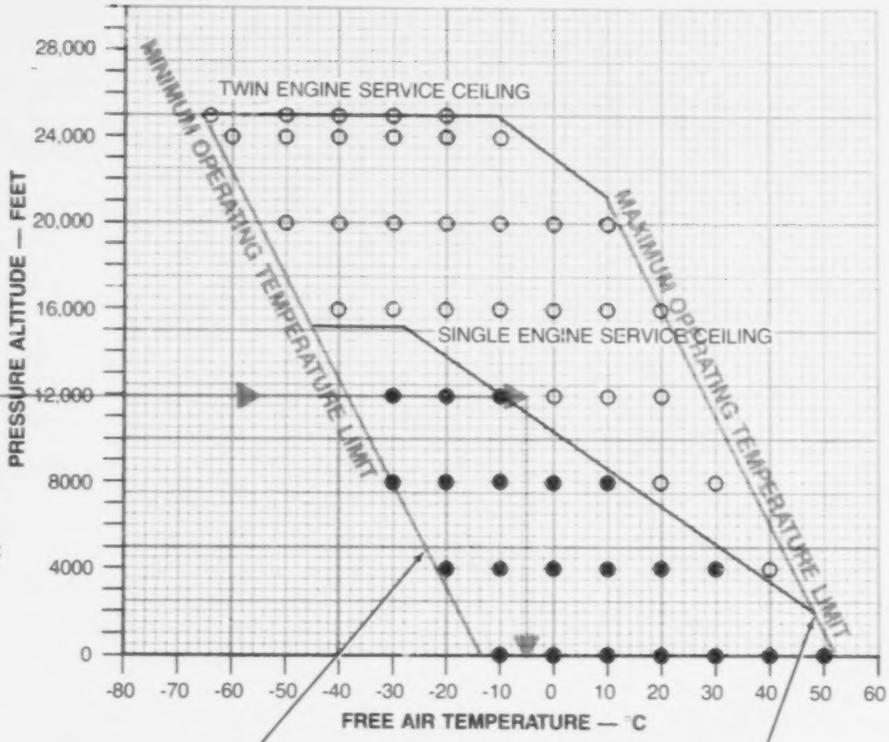
PRESSURE ALTITUDE = 12,000 FT
FAT = -5°C

METHOD

ENTER PRESSURE ALTITUDE HERE
MOVE RIGHT TO FAT
OPERATION IS WITHIN ENVELOPE
USE CRUISE CHARTS FOR 0°C AND -10°C AT 12,000 FT

NOTE

CIRCLES DENOTE CONDITIONS WHERE CRUISE PERFORMANCE IS PRESENTED. SHADED CIRCLES DENOTE CONDITIONS WHERE TWO ENGINE AND SINGLE ENGINE CRUISE PERFORMANCE IS PRESENTED.



AIRCRAFT OPERATION BELOW MINIMUM OPERATING TEMPERATURE LIMIT ARE SHOWN ON PERFORMANCE CHARTS AS DASHED LINES.

NO AIRCRAFT PERFORMANCE OR ENGINE OPERATING CHARACTERISTICS HAVE BEEN 0DEMONSTRATED ABOVE THE MAXIMUM OPERATING TEMPERATURE LIMIT.

R ▨
G ▨

AP 000961

DATA BASIS: ESTIMATED

Figure 7-16. Operation Envelope

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SECTION XIII. CRUISE CLIMB

7-47. Description.

The Cruise Climb Chart (fig. 7-17), shows the time, fuel, and distance required to climb from sea level. For climb at other than the conditions of this chart, refer to Cruise Charts (fig. 7-18 thru fig. 7-70), and the Climb/Descent Chart (fig. 7-71).

7-48. Use of Chart.

To determine the time, fuel and distance required to climb from on altitude to another, subtract the time, fuel and distance from sea level to the initial altitude as shown.

7-49. Condition.

a. Power - Maximum cruise climb power at 2000 RPM.

b. Climb Speed - 140 KIAS.

c. Flaps - UP.

d. Landing gear - UP.

e. Atmosphere - Temperature lapse rate is assumed to be linear from the initial altitude to the final altitude. Distances to climb are based on calm wind.

NOTE

Time and fuel to climb are not affected by wind.

CRUISE CLIMB

GEAR UP FLAPS 0 PERCENT CALM WIND
POWER — CRUISE CLIMB
140 KIAS

CRUISE CLIMB
U-21A
T74-CP-700

EXAMPLE

WANTED

TIME, FUEL, AND DISTANCE REQUIRED TO CLIMB

KNOWN

INITIAL FAT = 12°C
INITIAL PRESSURE ALTITUDE = 4307 FT
INITIAL WEIGHT = 9650 LBS
FINAL FAT = -5°C
FINAL PRESSURE ALTITUDE = 12,000 FT

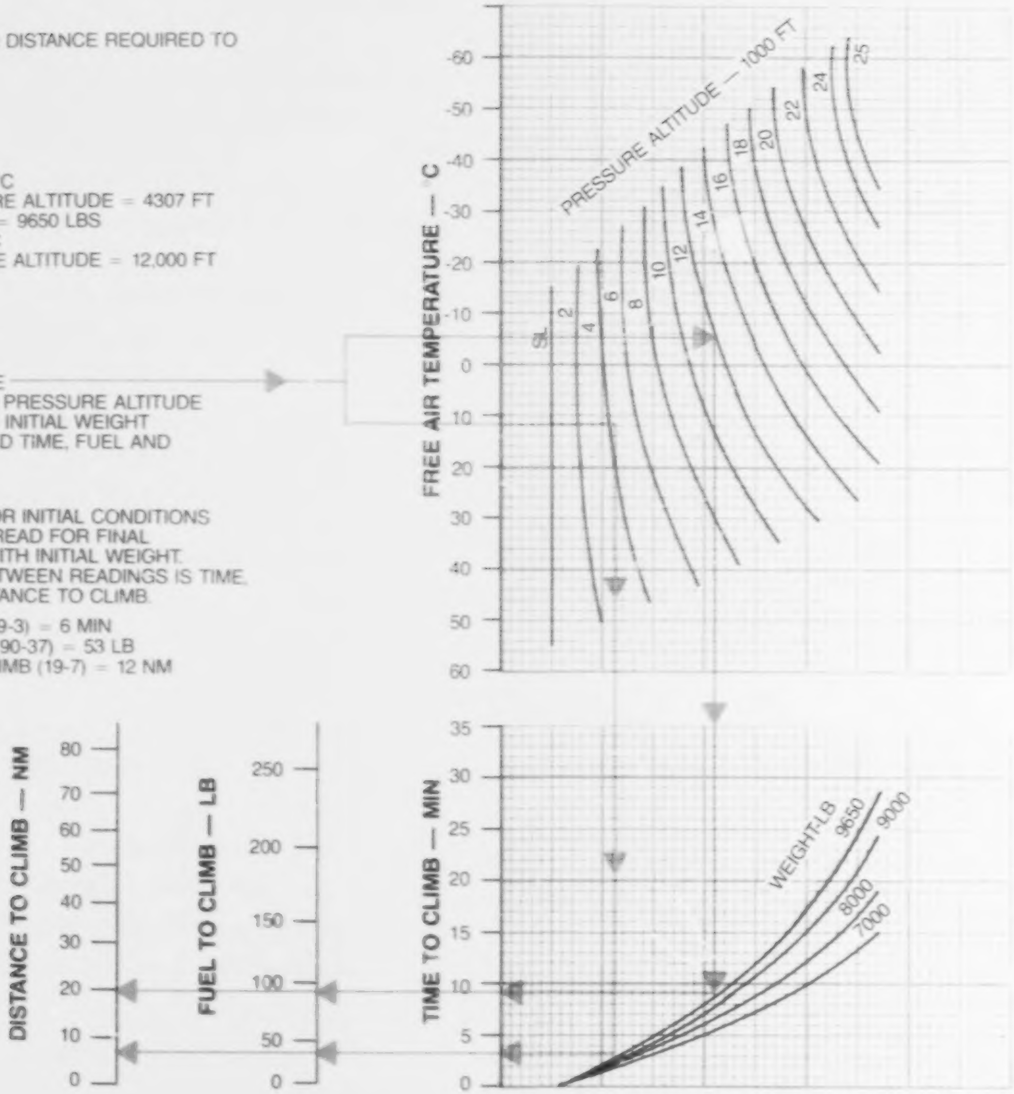
METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE
MOVE DOWN TO INITIAL WEIGHT
MOVE LEFT, READ TIME, FUEL AND DISTANCE

NOTE

READ GRAPH FOR INITIAL CONDITIONS AND SECOND READ FOR FINAL CONDITIONS WITH INITIAL WEIGHT. DIFFERENCE BETWEEN READINGS IS TIME, FUEL AND DISTANCE TO CLIMB.

TIME TO CLIMB (9-3) = 6 MIN
FUEL TO CLIMB (90-37) = 53 LB
DISTANCE TO CLIMB (19-7) = 12 NM



AP 000965

DATA BASIS: FLIGHT TEST

Figure 7-17. Cruise Climb

SECTION XIV. CRUISE

7-50. Description.

The Cruise Charts (fig. 7-18 thru fig. 7-70), show the horsepower per engine for various airspeeds and weights at selected combinations of altitude and temperature. Cruise and climb fuel flows are shown corresponding to engine power. Maximum performance lines are shown. Torque variation with propeller speed and engine horsepower are shown. Two engine and single-engine data are presented on the chart. Each individual chart is for a single pressure altitude and FAT.

7-51. Use of Chart.

The primary use of the Cruise Chart is shown in the Cruise Example (fig. 7-18). Other uses for the chart are described under "Other uses for Chart" (para. 7-53). The Cruise charts are for use in determining power settings to obtain a desired level of performance for a known n set of conditions of altitude, temperature, weight and number of operating engines. Normally, sufficient accuracy can be obtained by selecting the chart nearest to the planned cruising altitude and temperature. If greater accuracy is desired, interpolation between two or more charts should be used. The power setting is obtained by adjusting torque and propeller speed.

a. Maximum Range. The maximum range line shows the airspeed which will provide the maximum range for a given aircraft weight at the chart conditions.

b. Maximum Endurance. The maximum endurance line shows the airspeed which will provide maximum endurance for a given aircraft weight at the chart conditions.

c. Maximum Rate-of-Climb The maximum rate-of-climb line shows the airspeed which would provide maximum rate-of-climb for a given aircraft weight if maximum horsepower was used at the chart conditions.

d. Airspeed. The relationship between indicated and true airspeed is shown for the specific chart conditions of altitude and temperature. Conversion between the two airspeeds can be accomplished without regard to other chart information.

e. Fuel Flow. The fuel flow for cruise and climb settings is shown.

NOTE

Fuel flow values should be doubled for two engine operation.

f. Horsepower Per Engine. Horsepower per engine, although not readable in the cockpit is utilized in conjunction with the Climb/Descent Chart (fig. 7-71), to obtain rate-of-climb or descent.

7-52. Conditions.

a. Configuration -All cruise data are based on the aircraft in a clean configuration.

b. Fuel -Fuel flow is based on use of JP-4 aviation fuel.

c. Operation. Areas not recommended for cruise operation are shown in yellow.

7-53. Other uses for Chart.

a. Selected True Airspeed

Wanted

Indicated airspeed, horsepower per engine. Fuel Flow, and torque for a selected cruise true airspeed.

Known

Pressure altitude

FAT

Weight

Prop RPM

Method

Enter chart for true airspeed

Move left

Read indicated airspeed

Move down from weight line

Read horsepower per engine

Move down

Read fuel flow

Move left from prop RPM

Read Torque

b. Climb Conditions.

Wanted

Maximum rate-of-climb airspeed.

Horsepower required for level flight at MAX R/C airspeed.

Max horsepower available.

Fuel flow and Torque pressure for MAX R/C.

Excess horsepower available for climb.

Known

Pressure altitude

FAT

Weight

Prop RPM

Method

Enter chart at MAX R/C line.

Move right and up to weight.

Move left and read MAX R/C true airspeed.

Move right and read MAX R/C indicated airspeed

Move down from weight line.

Read horsepower per engine for level flight at MAX R/C airspeed.

Read Max horsepower available per engine at MAC R/C airspeed.

Move Down for MAX horsepower

Read climb fuel flow.

Move left from prop RPM line.

Read torque.

Determine excess horsepower per engine available for climb - MAX horsepower available per engine less horsepower per engine for level flight.

CRUISE

PRESSURE ALTITUDE 12,000 FT EXAMPLE
FLAPS UP GEAR UP

WANTED

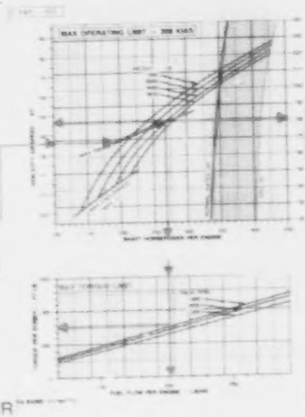
TRUE AIRSPEED, INDICATED AIRSPEED, HORSEPOWER PER ENGINE, FUEL FLOW PER ENGINE, AND TORQUE FOR MAX RANGE CRUISE

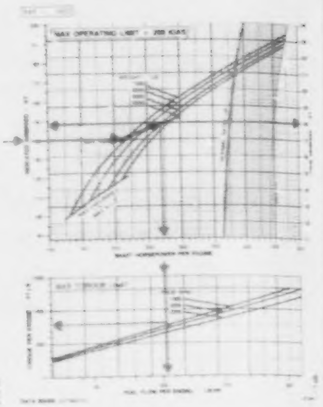
KNOWN

WEIGHT = 9000 LB
PRESSURE ALTITUDE = 12,000 FT
FAT = -5°C
PROP SPEED = 1900 RPM

METHOD 1 (SIMPLEST)

USE CHART FOR NEXT HIGHER CONDITION (0°C)
ENTER MAX RANGE HERE
MOVE RIGHT AND UP TO WEIGHT
MOVE RIGHT, READ TRUE AIRSPEED = 180 KTAS
MOVE LEFT, READ INDICATED AIRSPEED = 146 KIAS
MOVE DOWN, READ HORSEPOWER PER ENGINE = 268 SHP
MOVE DOWN, READ FUEL FLOW PER ENGINE = 200 LB/HR
MOVE LEFT FROM PROP RPM, READ TORQUE PER ENGINE = 750 FT-LB





METHOD 2 (INTERPOLATE)

READ TRUE AIRSPEED, INDICATED AIRSPEED, HORSEPOWER, FUEL FLOW, AND TORQUE AT EACH ADJACENT ALTITUDE AND FAT, THEN INTERPOLATE

ALTITUDE	12,000 FT	12,000 FT	12,000 FT
FAT	-10°C	-5°C	0°C
TRUE AIRSPEED	179	180	180
INDICATED AIRSPEED	147	147	146
HORSEPOWER	269	269	268
FUEL FLOW	201	201	200
TORQUE	750	750	750

WANTED

INDICATED AIRSPEED, HORSEPOWER PER ENGINE, FUEL FLOW, AND TORQUE FOR A DESIRED TRUE AIRSPEED

KNOWN

DESIRED TRUE AIRSPEED = 200 KTS
WEIGHT = 9000 LB
PRESSURE ALTITUDE = 12,000 FT
FAT = 0°C
PROP SPEED = 1900 RPM

METHOD

ENTER DESIRED TRUE AIRSPEED ON RIGHT = 200 KTAS
MOVE LEFT TO WEIGHT AND INDICATED AIRSPEED = 163 KIAS
MOVE DOWN FROM WEIGHT, READ HORSEPOWER = 333 SHP
MOVE DOWN, READ FUEL FLOW = 235 LB/HR
MOVE LEFT FROM PROP RPM, READ TORQUE = 920 FT-LB

WANTED

MAX RATE OF CLIMB, INDICATED AIRSPEED, HORSEPOWER PER ENGINE FOR LEVEL FLIGHT AT MAX R/C AIRSPEED, MAX CONT. HORSEPOWER AVAILABLE, EXCESS HORSEPOWER AVAILABLE FOR CLIMB, FUEL FLOW AND TORQUE FOR MAX CLIMB

KNOWN

WEIGHT = 9000 LB
PRESSURE ALTITUDE = 12,000 FT
FAT = 0°C
PROP SPEED = 2200 RPM

METHOD

ENTER CHART AT MAX R/C LINE
MOVE RIGHT AND UP TO WEIGHT = 9000 LB
MOVE LEFT, READ MAX R/C INDICATED AIRSPEED = 115 KIAS
MOVE DOWN FROM WEIGHT LINE, READ HORSEPOWER REQUIRED FOR LEVEL FLIGHT AT MAX R/C AIRSPEED = 194 SHP
MOVE RIGHT TO MAX CONT. HP AVAILABLE LINE, READ MAX CONT. HORSEPOWER AVAILABLE = 406 SHP
MOVE DOWN FROM MAX CONT. HP AVAILABLE, READ CLIMB FUEL FLOW = 270 LB/HR
MOVE LEFT FROM PROP RPM, READ TORQUE TO SET FOR CLIMB = 1000 FT-LB
DETERMINE EXCESS HORSEPOWER PER ENGINE AVAILABLE FOR CLIMB – MAX CONT. HORSEPOWER AVAILABLE, LESS HORSEPOWER REQUIRED FOR LEVEL FLIGHT = 406 SHP - 194 SHP = 212 SHP PER ENGINE

DATA BASIS: ESTIMATED

AP000575

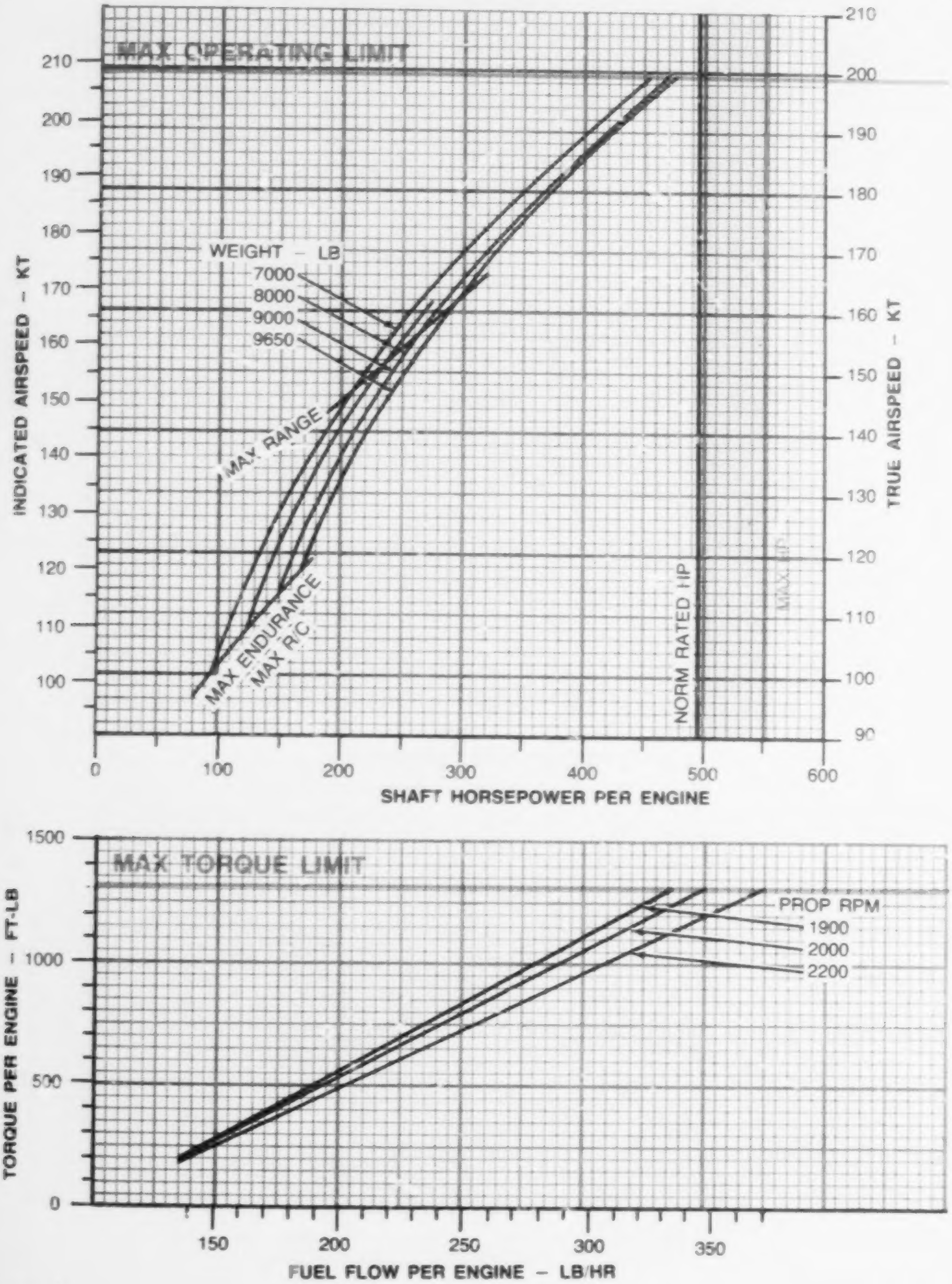
Figure 7-18. Cruise Example

CRUISE
U-21A
T74-CP-700

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −10°C



DATA BASIS: ESTIMATED

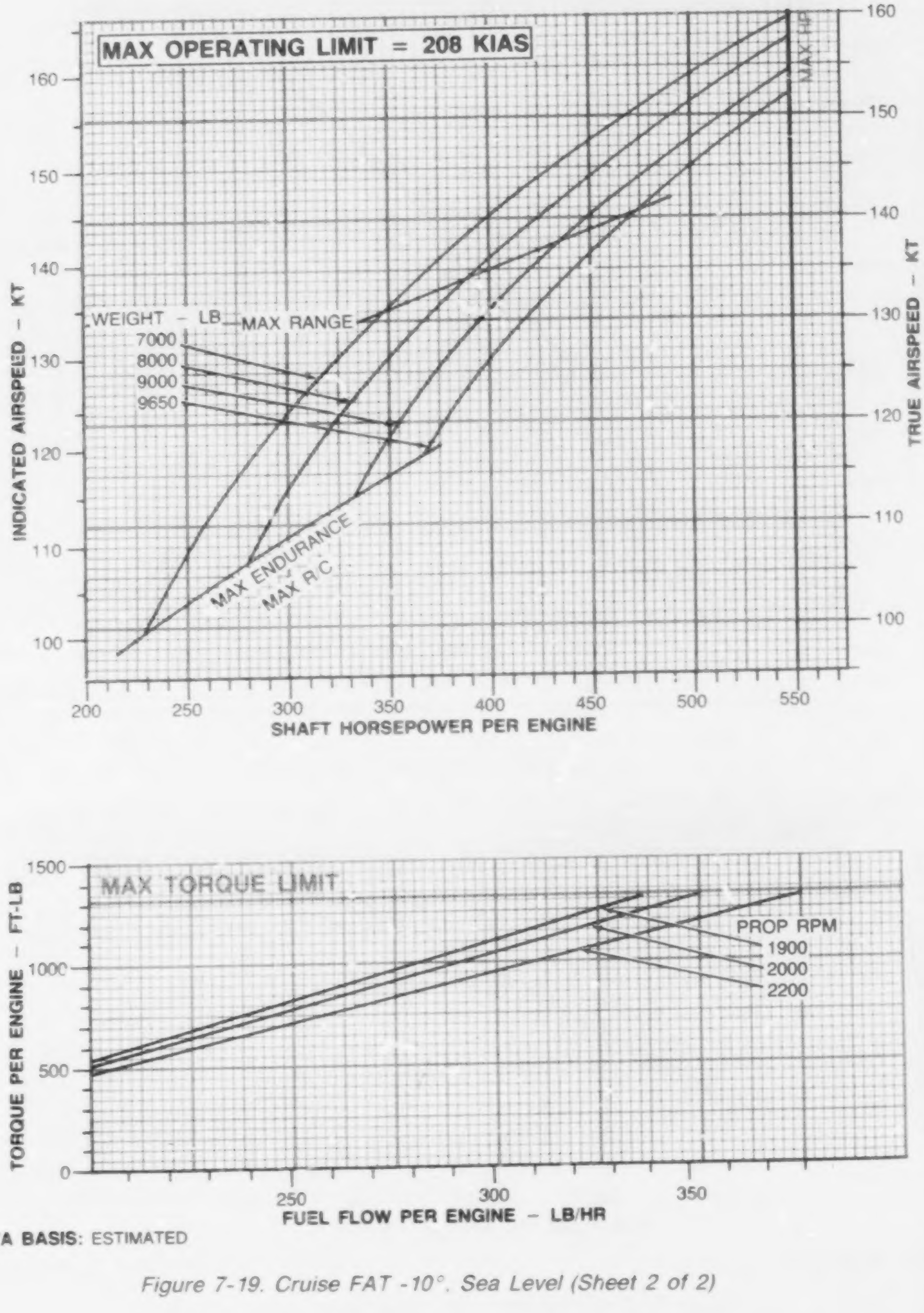
AP 004022.1

Figure 7-19. Cruise FAT -10°, Sea Level (Sheet 1 of 2)

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT GEAR UP

FAT = −10°C



DATA BASIS: ESTIMATED

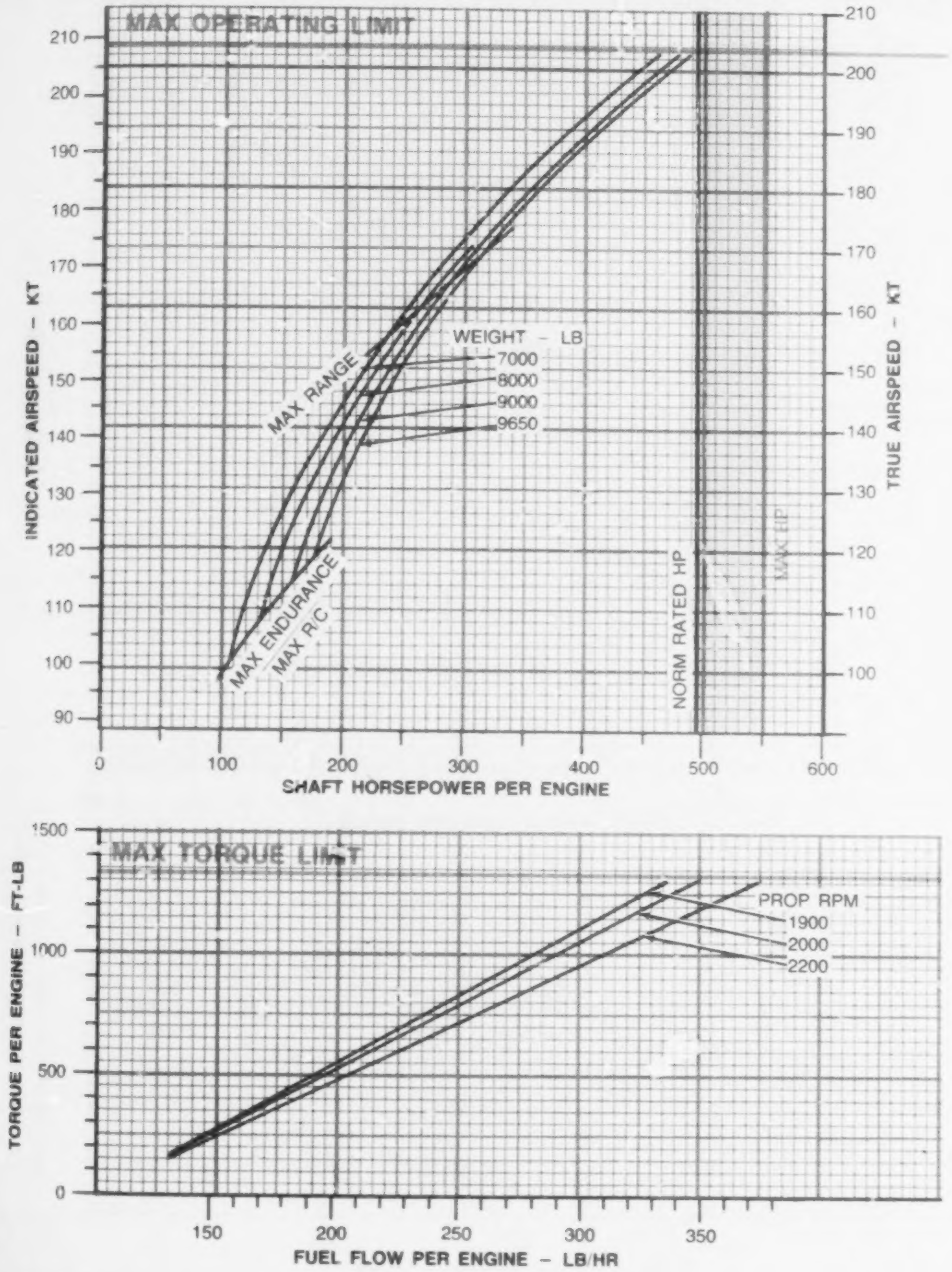
Figure 7-19. Cruise FAT -10°. Sea Level (Sheet 2 of 2)

CRUISE

CRUISE
U-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 0°C



DATA BASIS: ESTIMATED

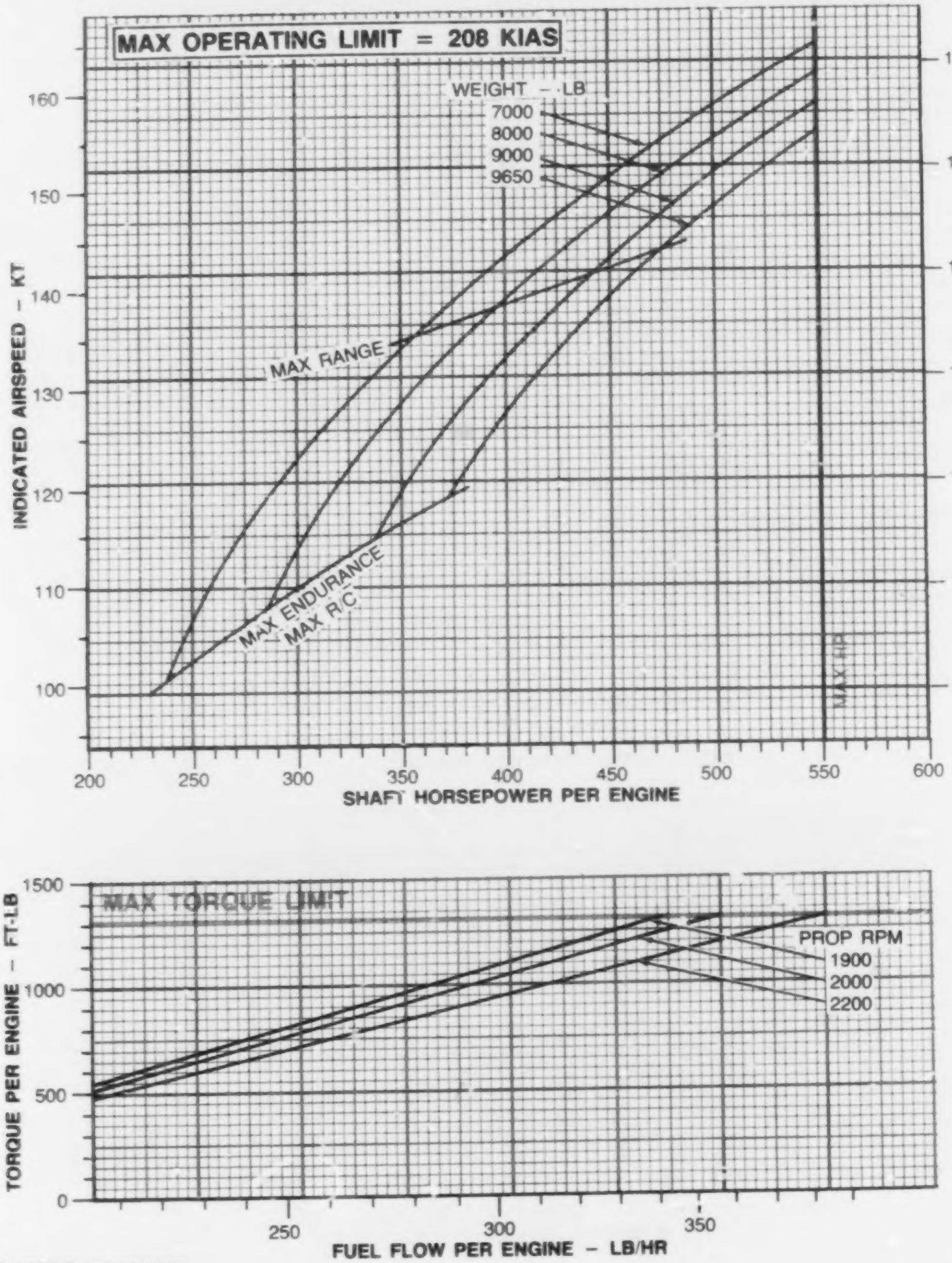
AP 004023.1

Figure 7-20. Cruise FAT 0°C, Sea Level (Sheet 1 of 2)

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 0°C



DATA BASIS: ESTIMATED

AP 004023.2

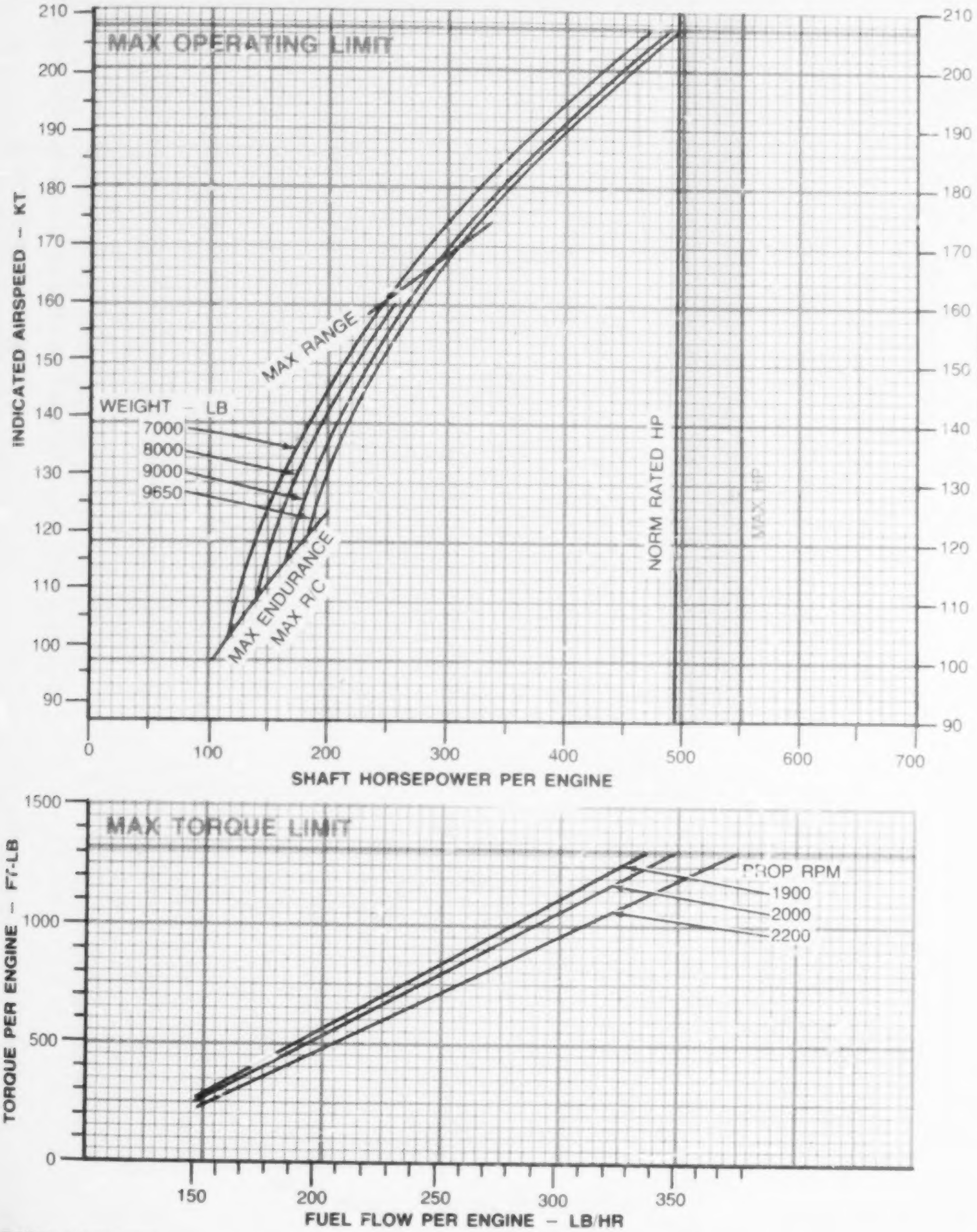
Figure 7-20. Cruise FAT 0°C, Sea Level (Sheet 2 of 2)

CRUISE

CRUISE
U-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 10°C



DATA BASIS: ESTIMATED

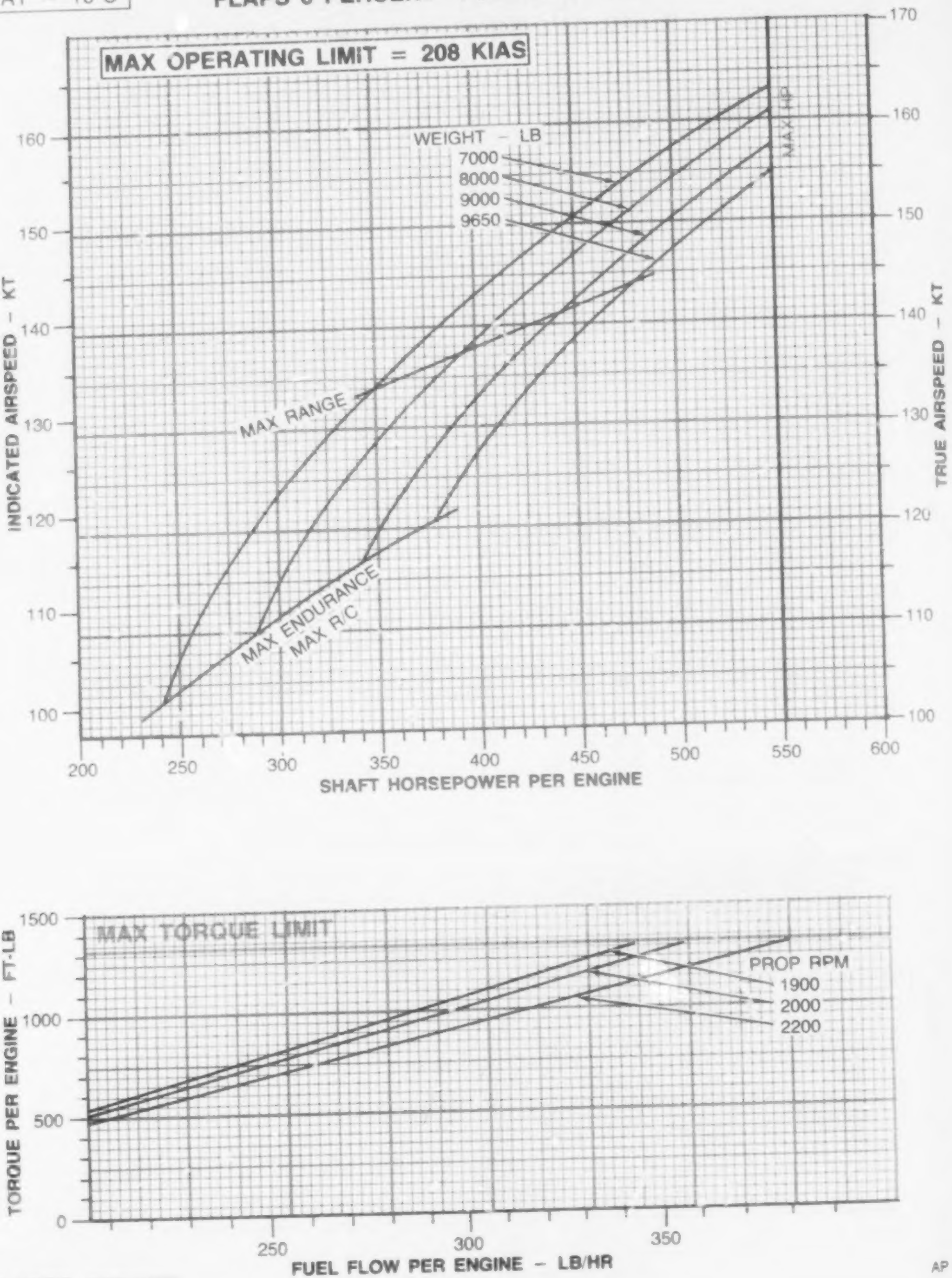
AP 004024 1

Figure 7-21. Cruise FAT 10°C. Sea Level (Sheet 1 of 2)

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 10°C



AP 004024 2

DATA BASIS: ESTIMATED

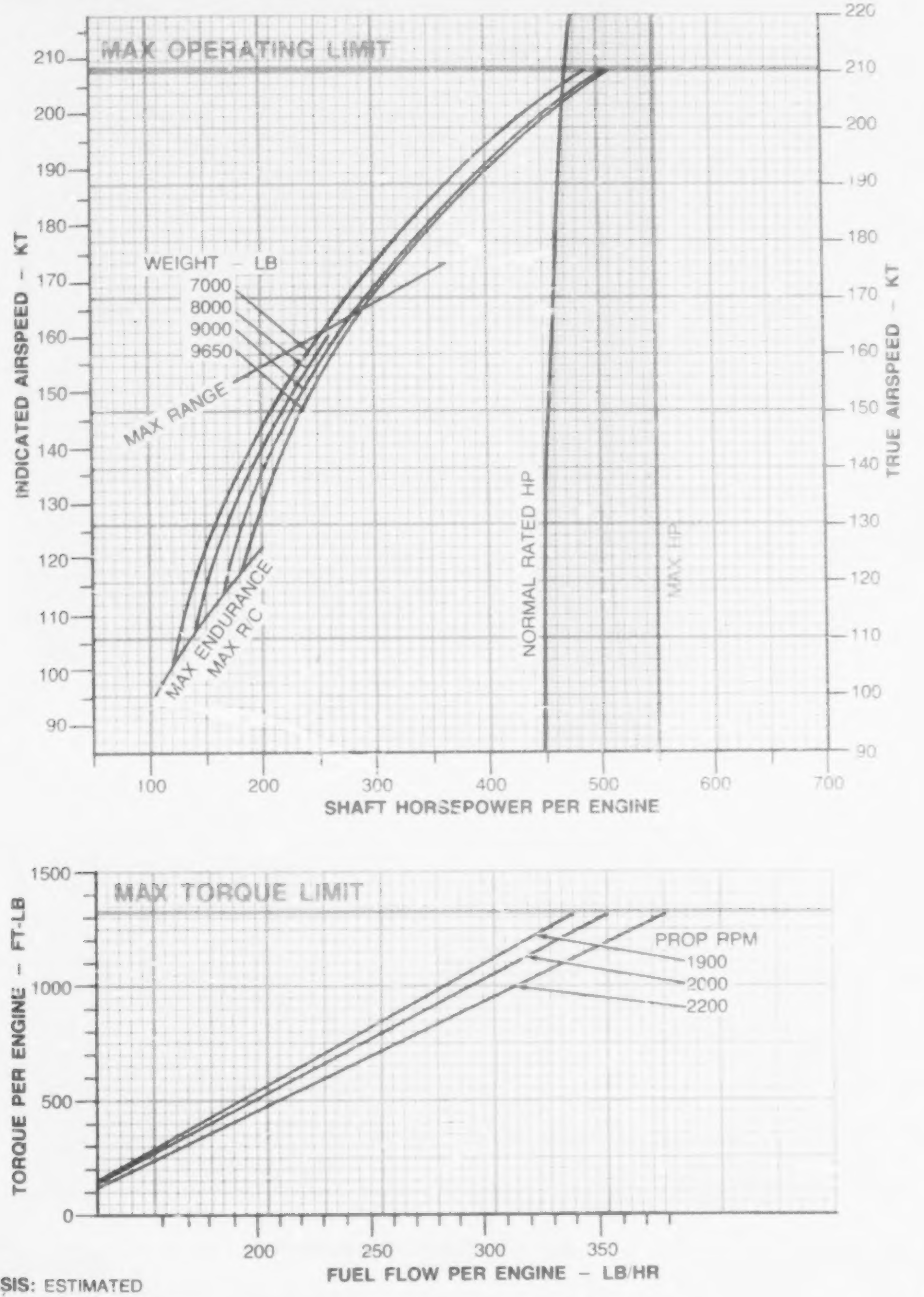
Figure 7-21. Cruise FAT 10°C, Sea Level (Sheet 2 of 2)

CRUISE

CRUISE
U-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 20°C



DATA BASIS: ESTIMATED

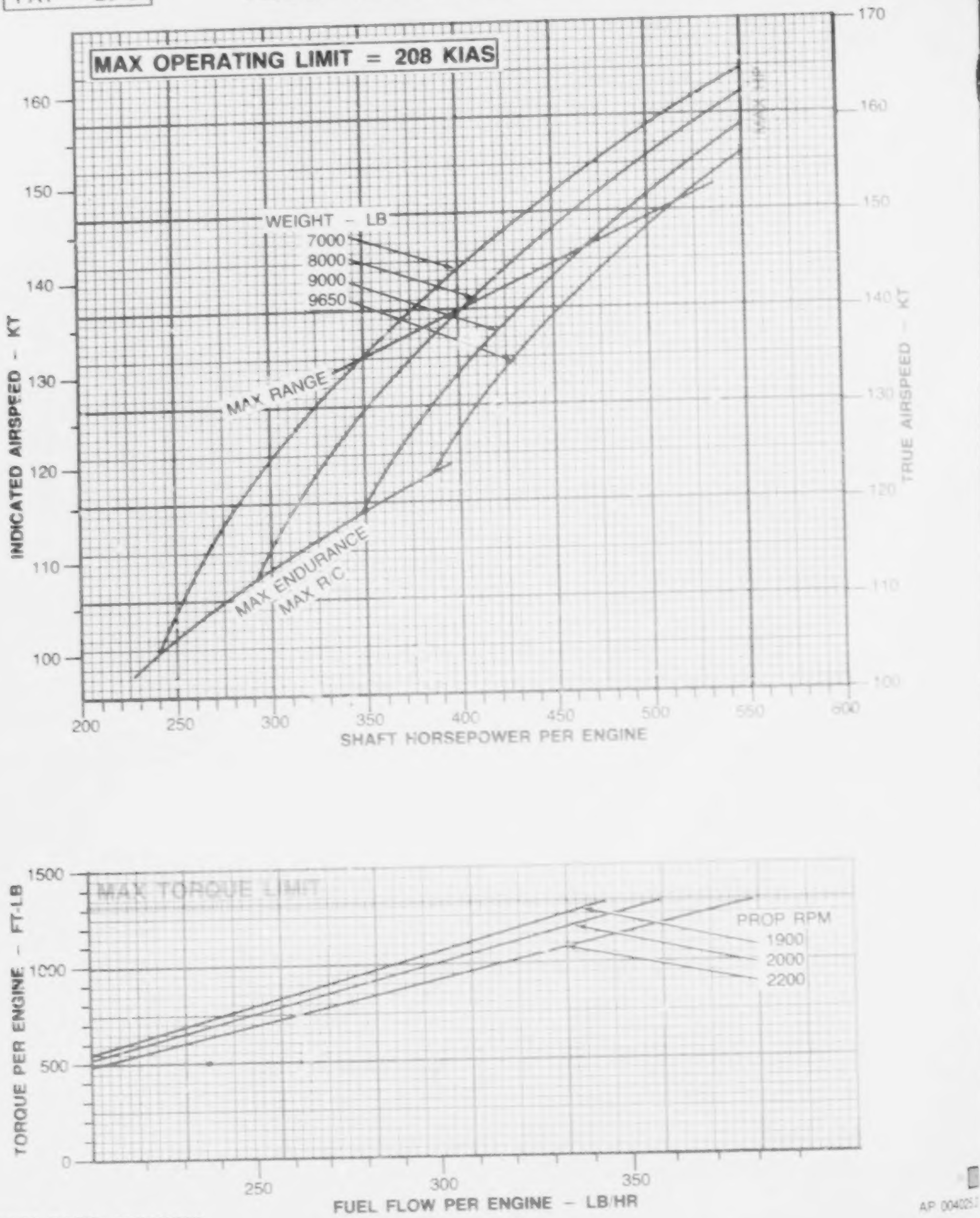
AP 004025.1

Figure 7-22. Cruise FAT 20°C, Sea Level (Sheet 1 of 2)

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 20°C



DATA BASIS: ESTIMATED

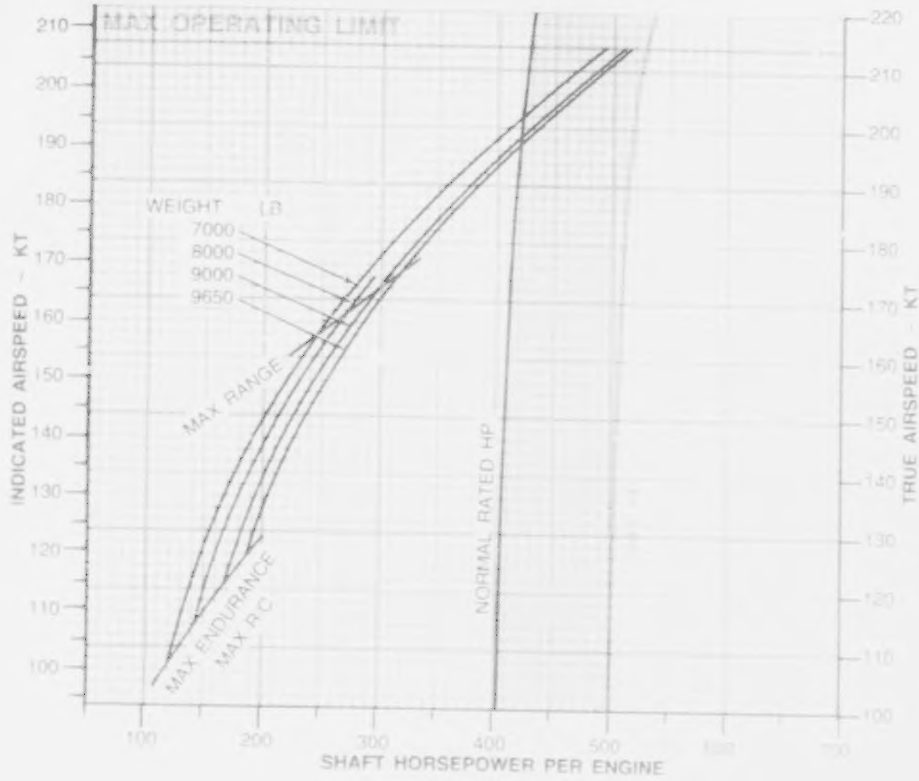
Figure 7-22. Cruise FAT 20°C, Sea Level (Sheet 2 of 2)

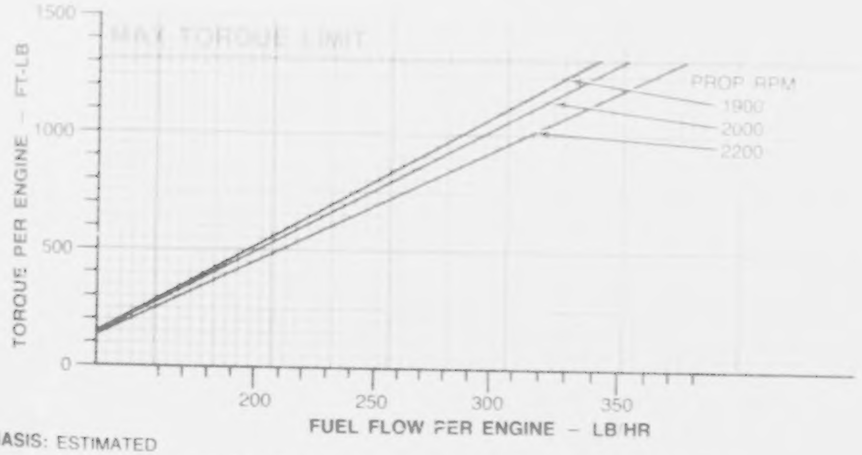
CRUISE

CRUISE
U-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 30°C





DATA BASIS: ESTIMATED

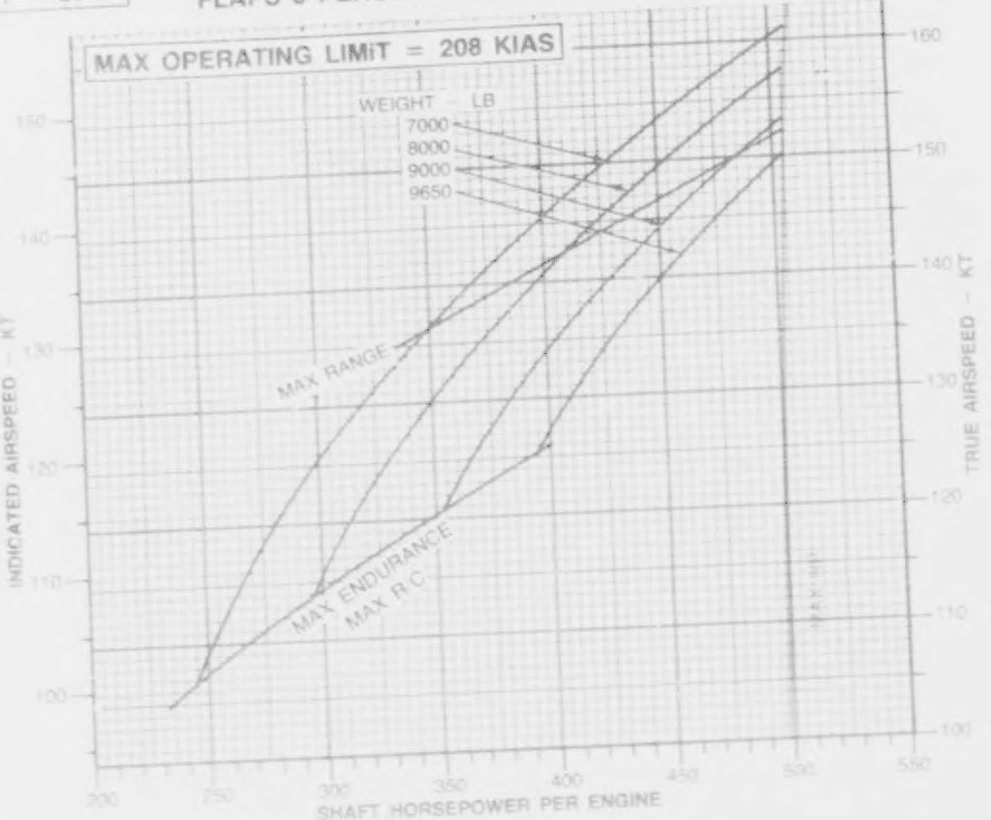
Figure 7-23. Cruise FAT 30°C, Sea Level (Sheet 1 of 2)

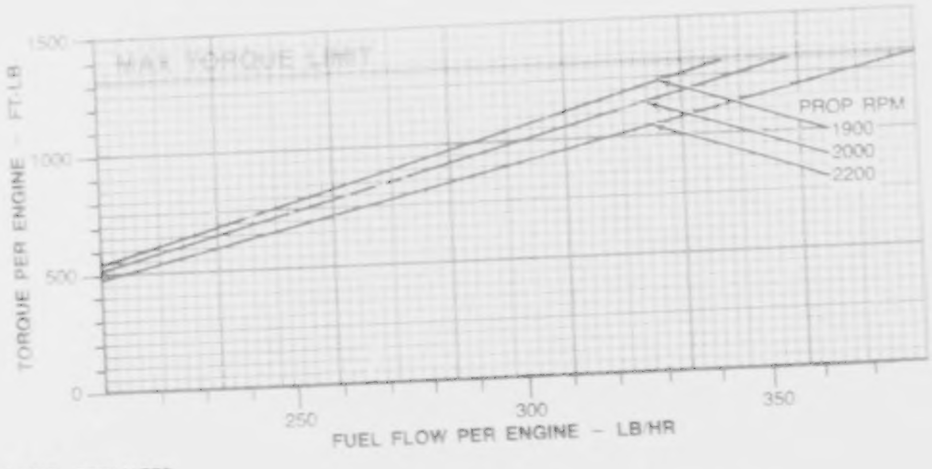
AP 004026 1

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 30°C





AP 004061

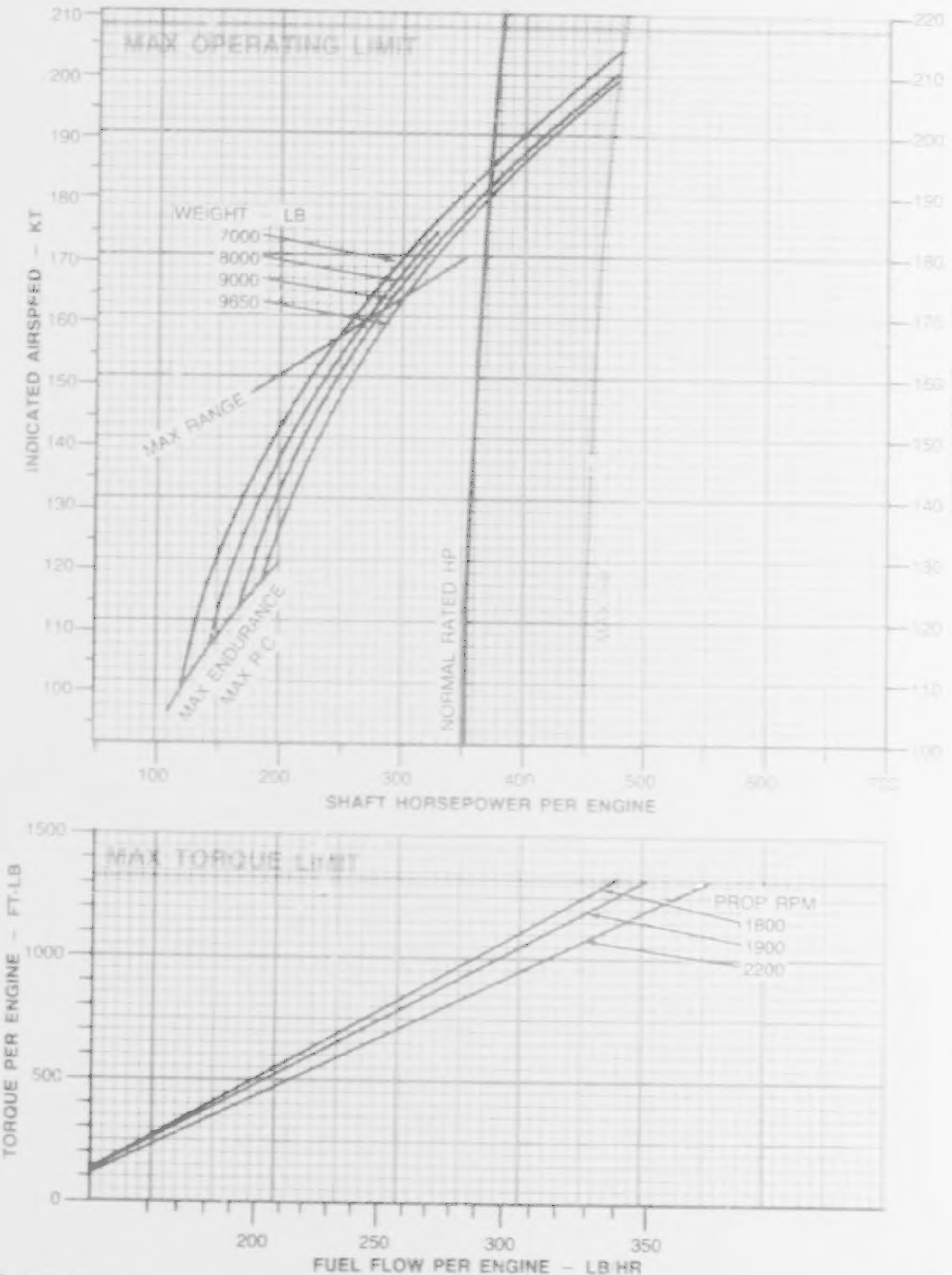
DATA BASIS: ESTIMATED

Figure 7-23. Cruise FAT 30°C, Sea Level (Sheet 2 of 2)

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 40°C



DATA BASIS: ESTIMATED

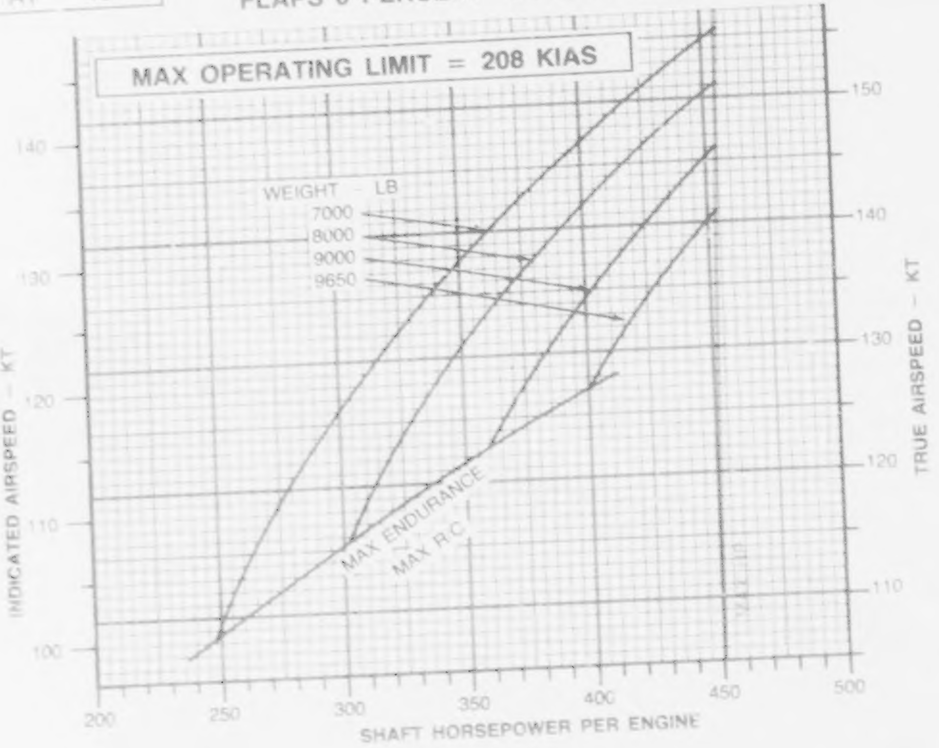
AP 004027.1

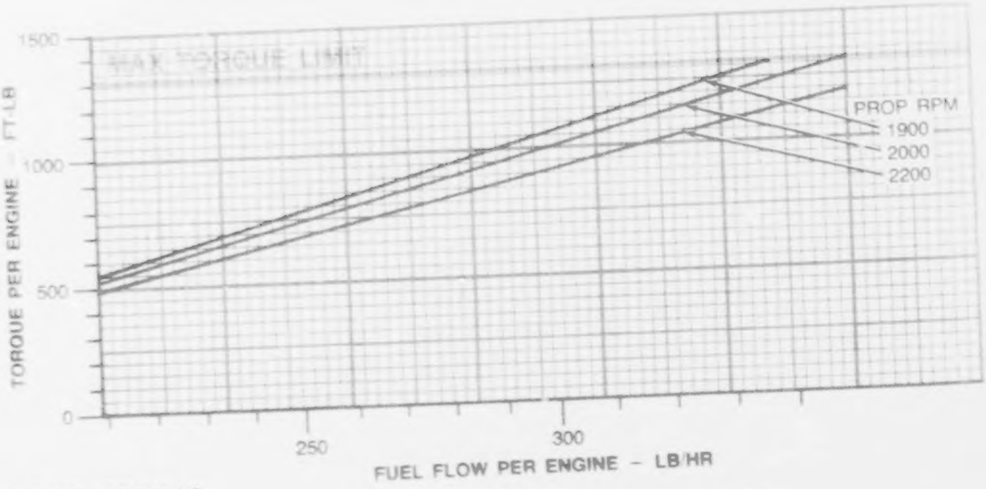
Figure 7-24. Cruise FAT 40°C, Sea Level (Sheet 1 of 2)

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 40°C





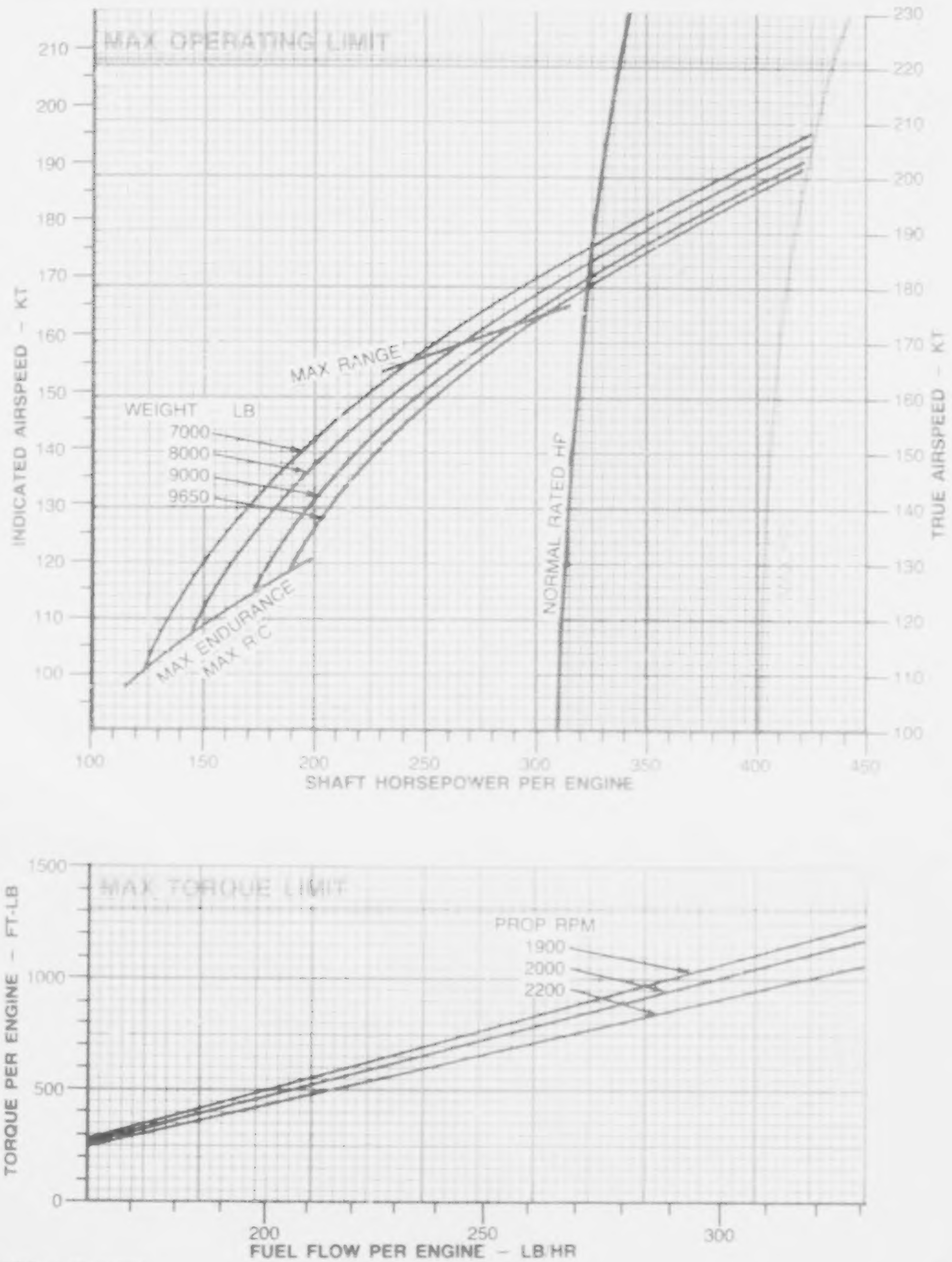
DATA BASIS: ESTIMATED

Figure 7-24. Cruise FAT 40°C, Sea Level (Sheet 2 of 2)

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 50°C



DATA BASIS: ESTIMATED

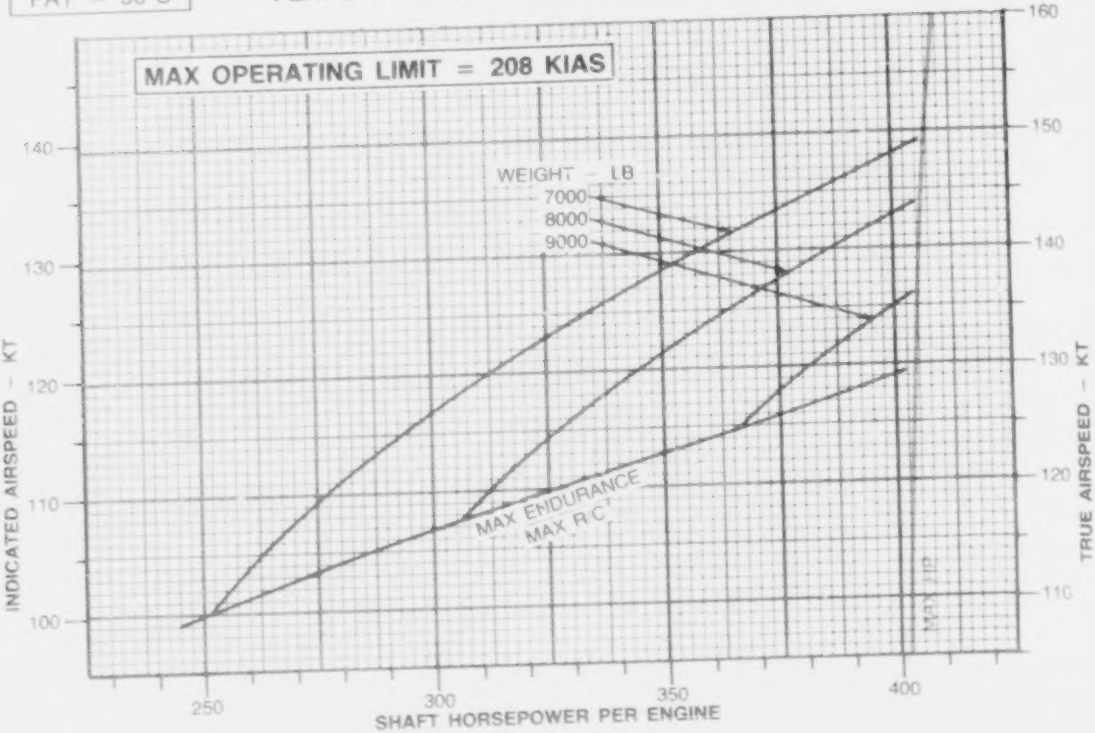
AP 004028 1

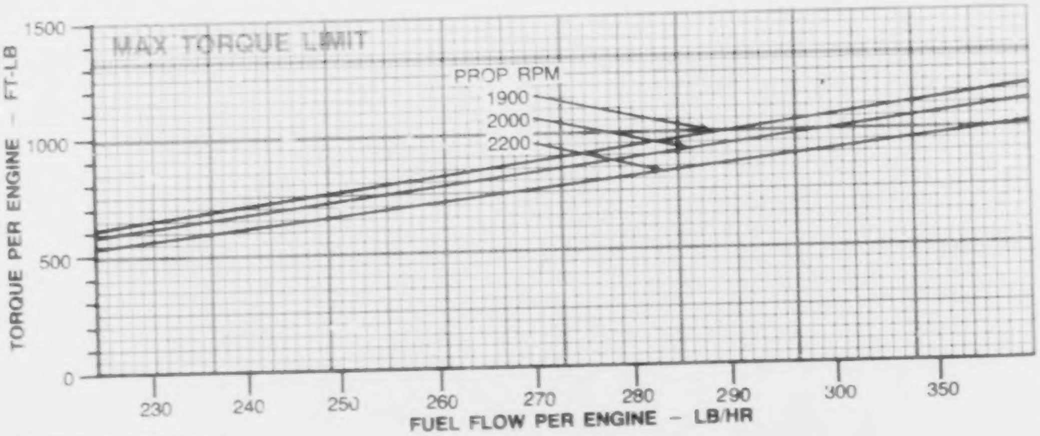
Figure 7-25. Cruise FAT 50°C, Sea Level (Sheet 1 of 2)

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 50°C





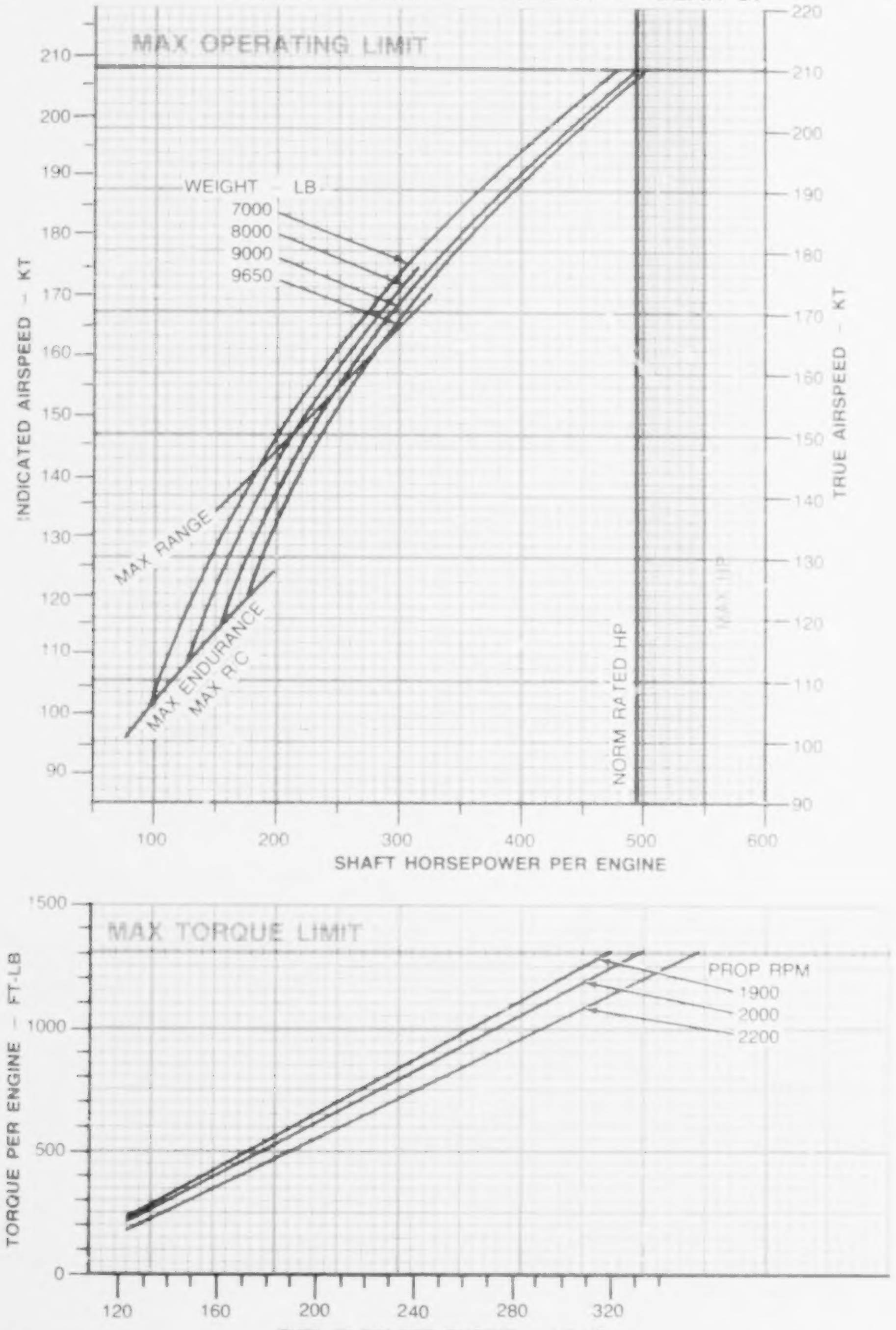
DATA BASIS: ESTIMATED

Figure 7-25. Cruise FAT 50°C, Sea Level (Sheet 2 of 2)

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = -20°C



DATA BASIS: ESTIMATED

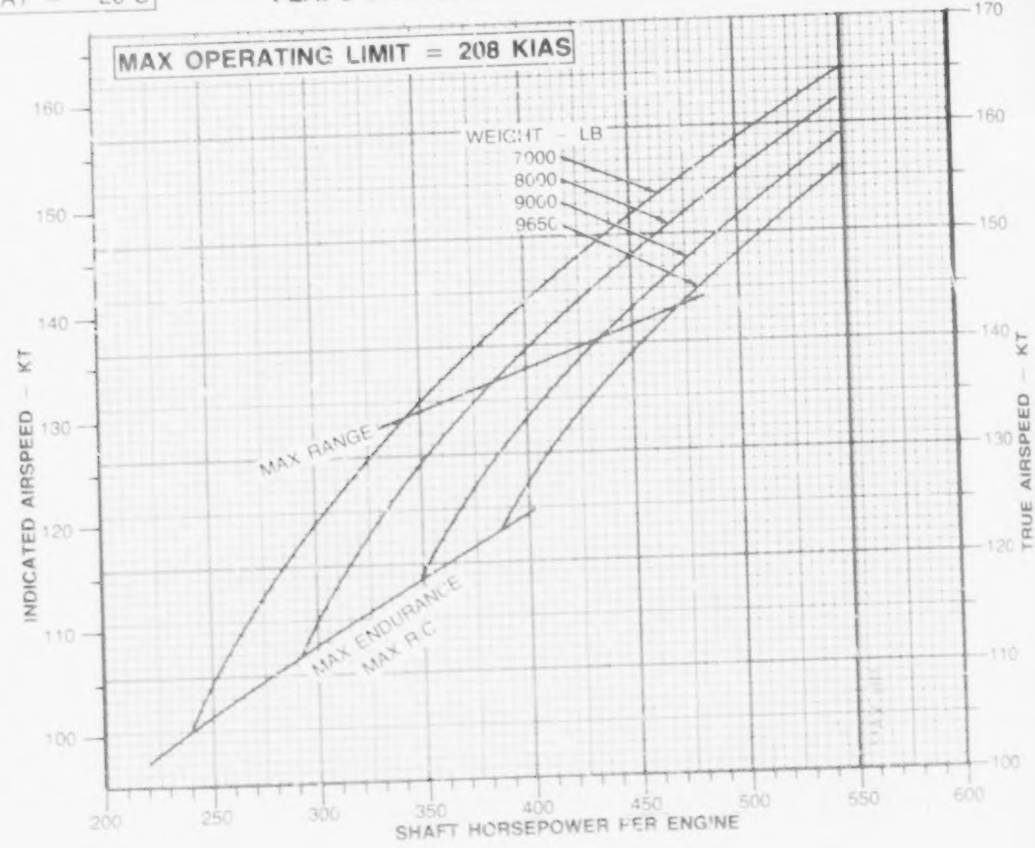
AP 004029 1

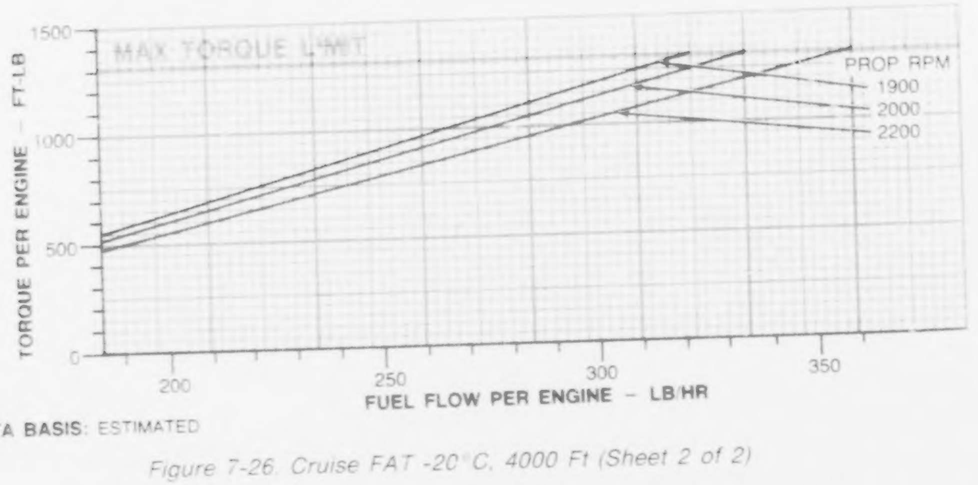
Figure 7-26. Cruise FAT -20°C, 4000 Ft (Sheet 1 of 2)

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT JP-4 GEAR UP

FAT = −20°C





DATA BASIS: ESTIMATED

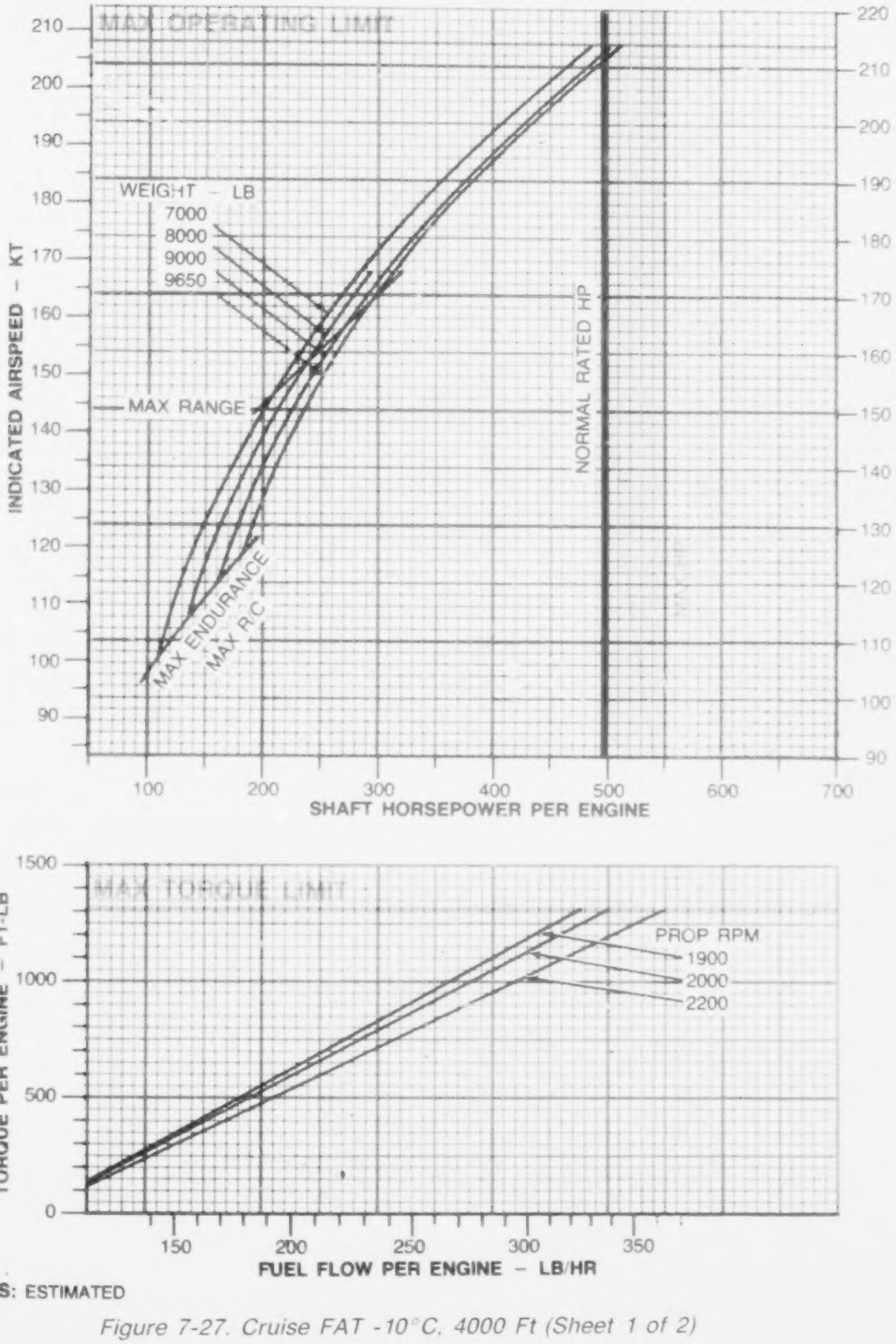
Figure 7-26. Cruise FAT -20°C, 4000 Ft (Sheet 2 of 2)

CRUISE

CRUISE
U-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −10°C



DATA BASIS: ESTIMATED

AP 004030.1

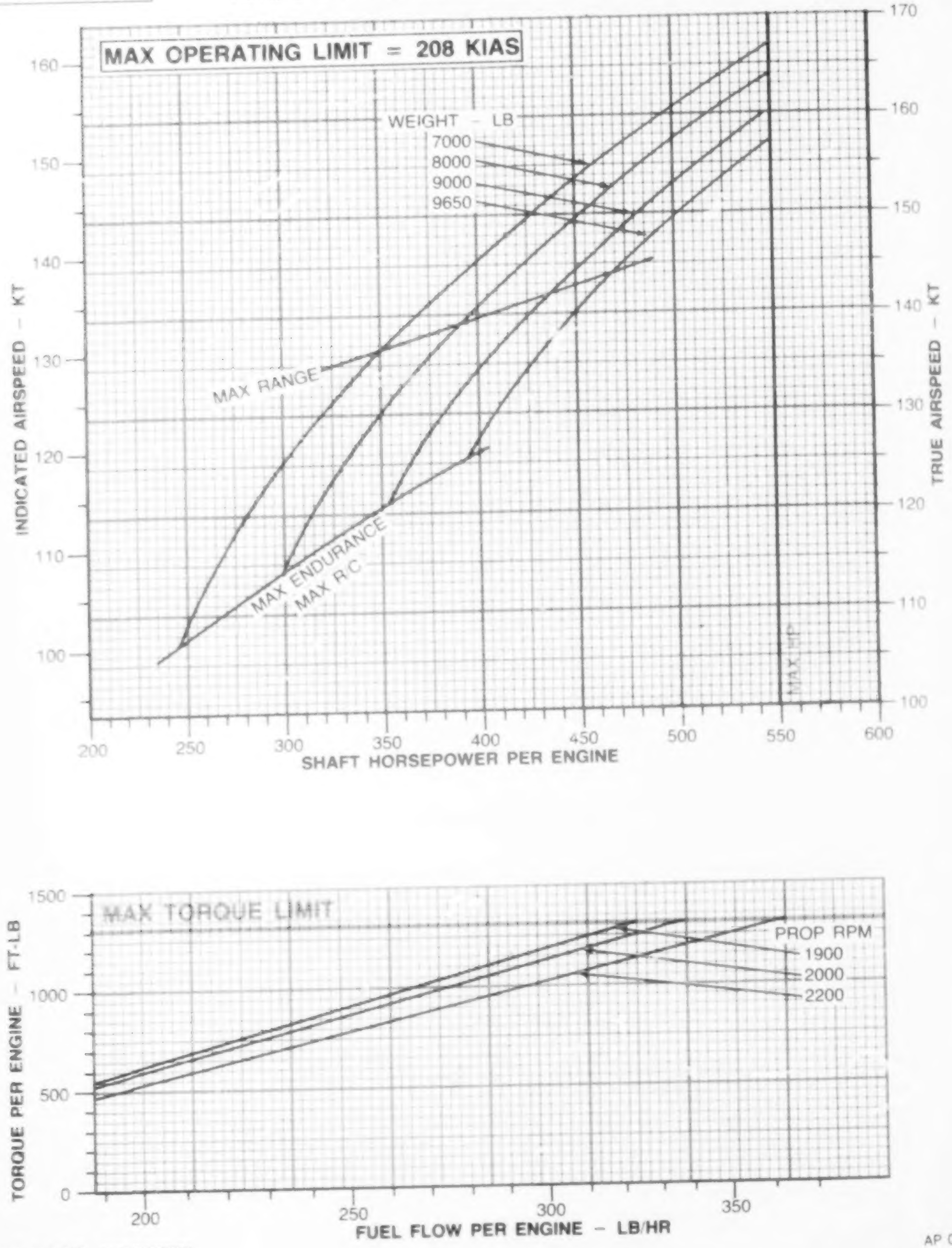
Figure 7-27. Cruise FAT -10°C, 4000 Ft (Sheet 1 of 2)

CRUISE
U-21A
T74-CP-700

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = -10°C



AP 004030 2

DATA BASIS: ESTIMATED

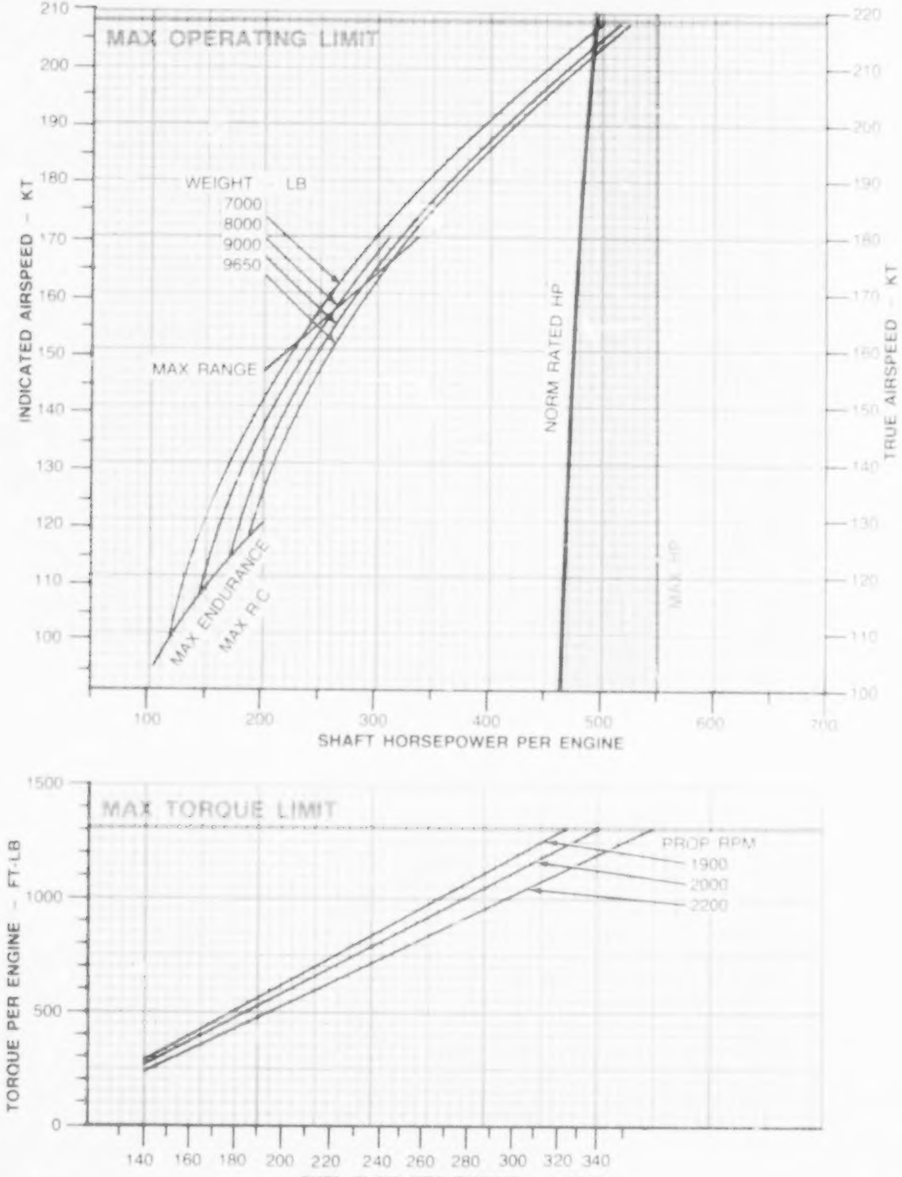
Figure 7-27. Cruise FAT -10°C, 4000 Ft (Sheet 2 of 2)

CRUISE

CRUISE
U-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 0°C



DATA BASIS: ESTIMATED

AP 004031.1

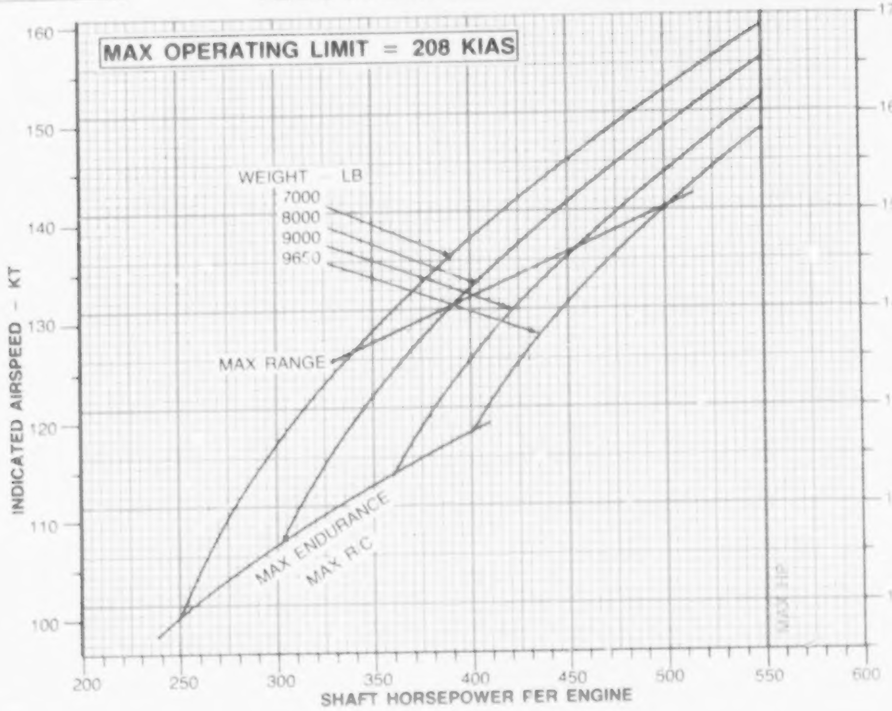
Figure 7-28. Cruise FAT -0°C, 4000 Ft (Sheet 1 of 2)

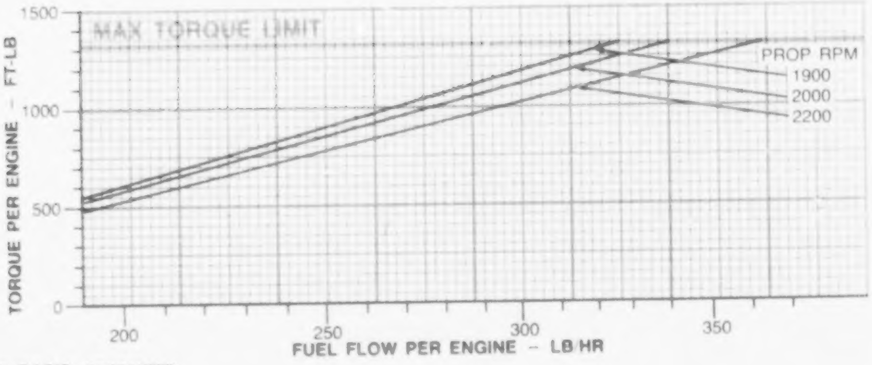
CRUISE

CRUISE
U-21A
T74-CP-700

SINGLE ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT JP-4 GEAR UP

FAT = 0°C





DATA BASIS: ESTIMATED

AP 004031 2

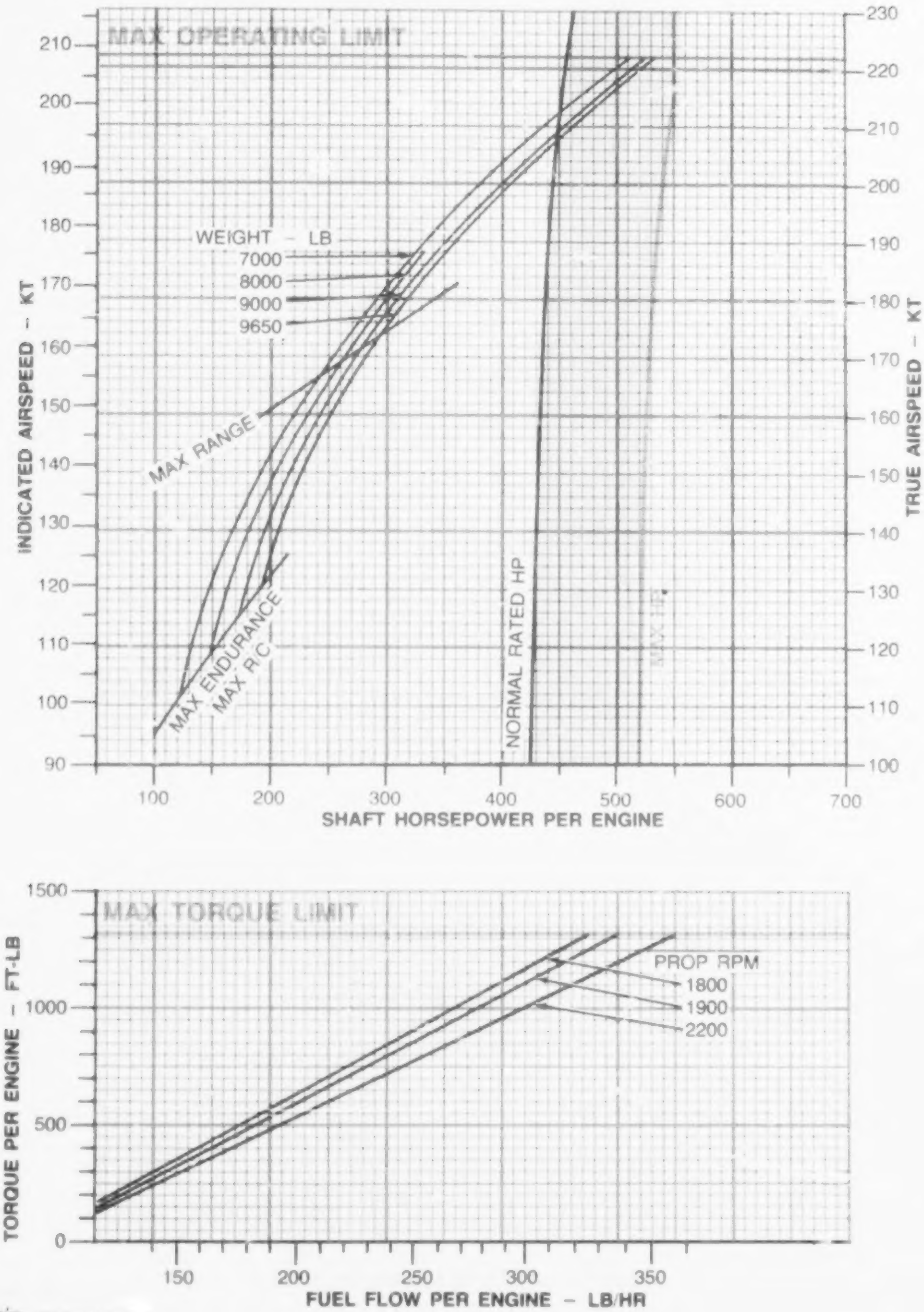
Figure 7-28. Cruise FAT -0°C, 4000 Ft (Sheet 2 of 2)

CRUISE

CRUISE
U-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 10°C



DATA BASIS: ESTIMATED

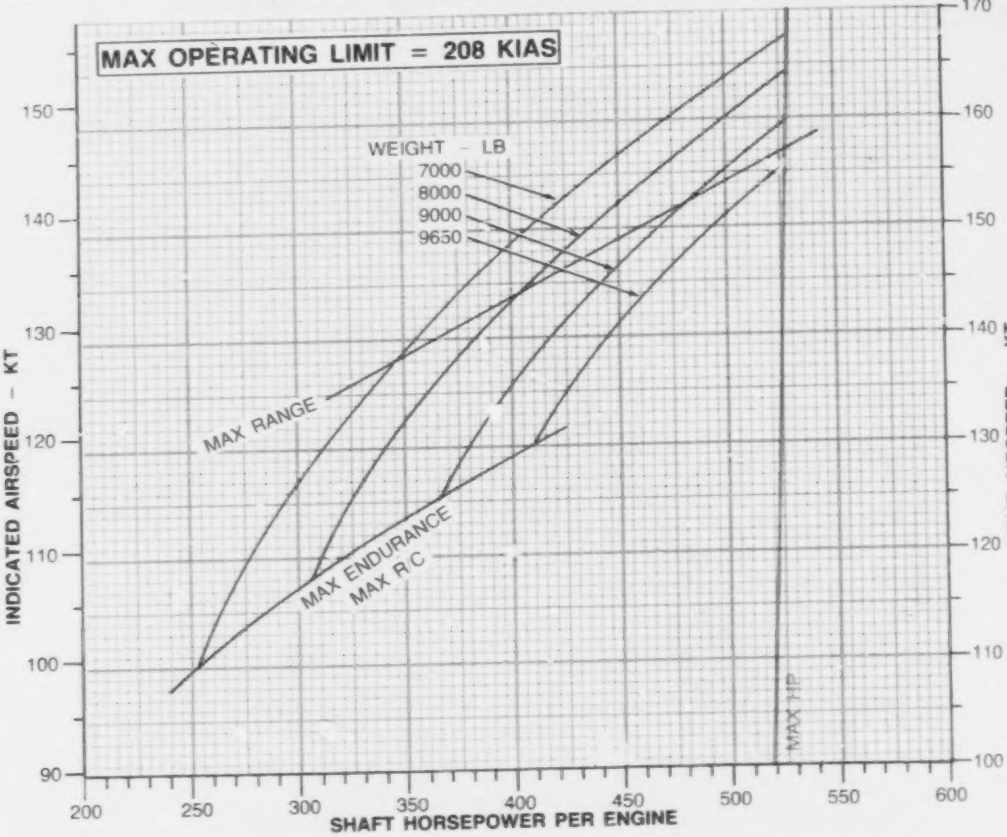
AP 004032.1

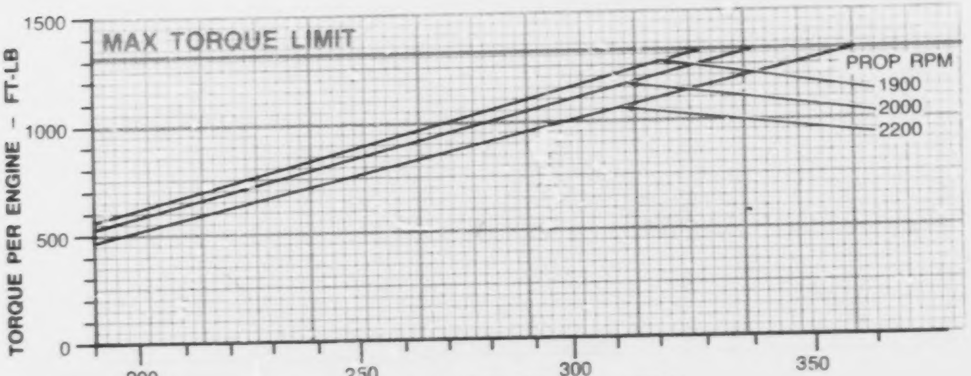
Figure 7-29. Cruise FAT 10°C, 4000 Ft (Sheet 1 of 2)

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 10°C





AP 004032.2

DATA BASIS: ESTIMATED

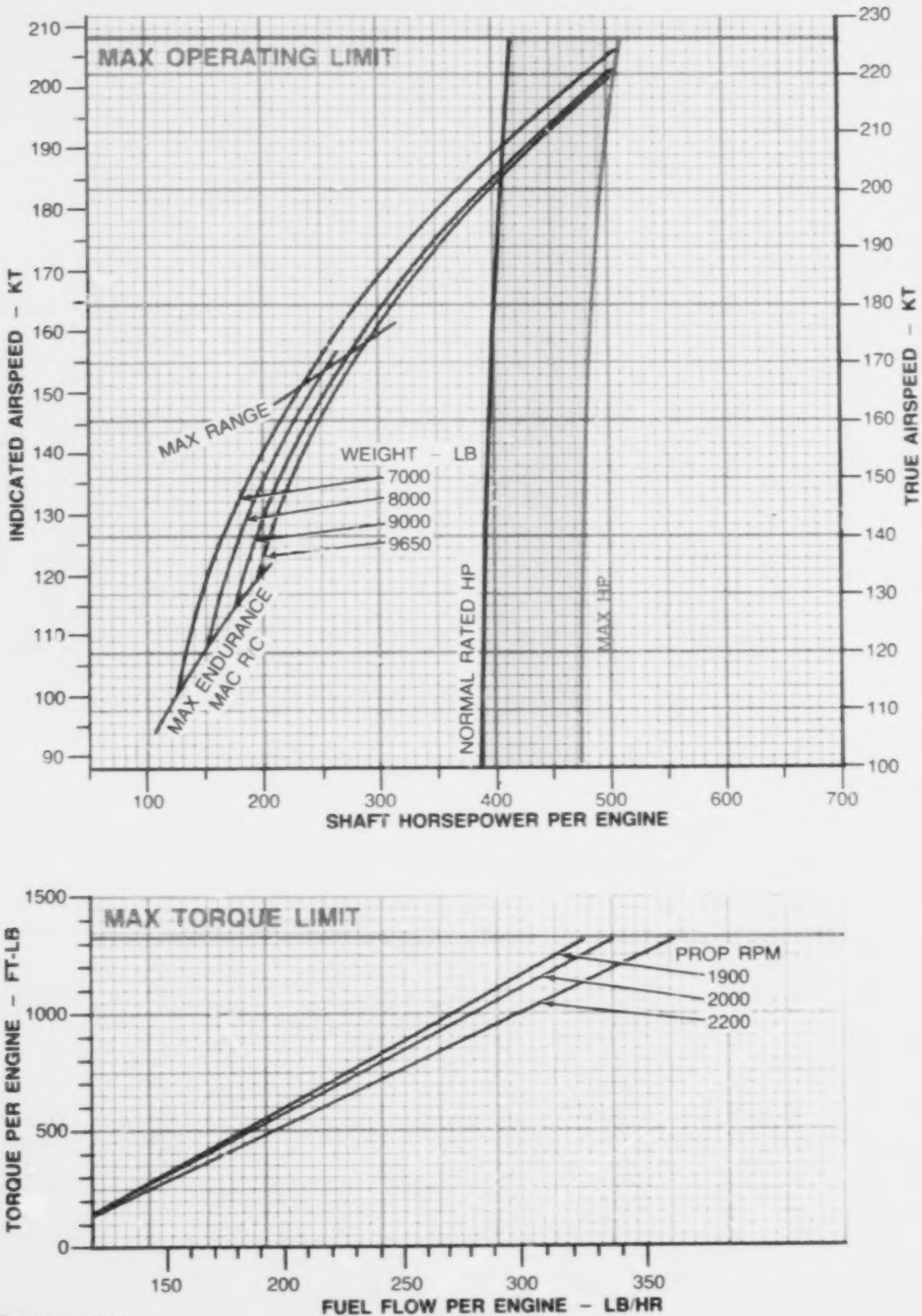
Figure 7-29. Cruise FAT 10°C, 4000 Ft (Sheet 2 of 2)

CRUISE

CRUISE
U-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 20°C



DATA BASIS: ESTIMATED

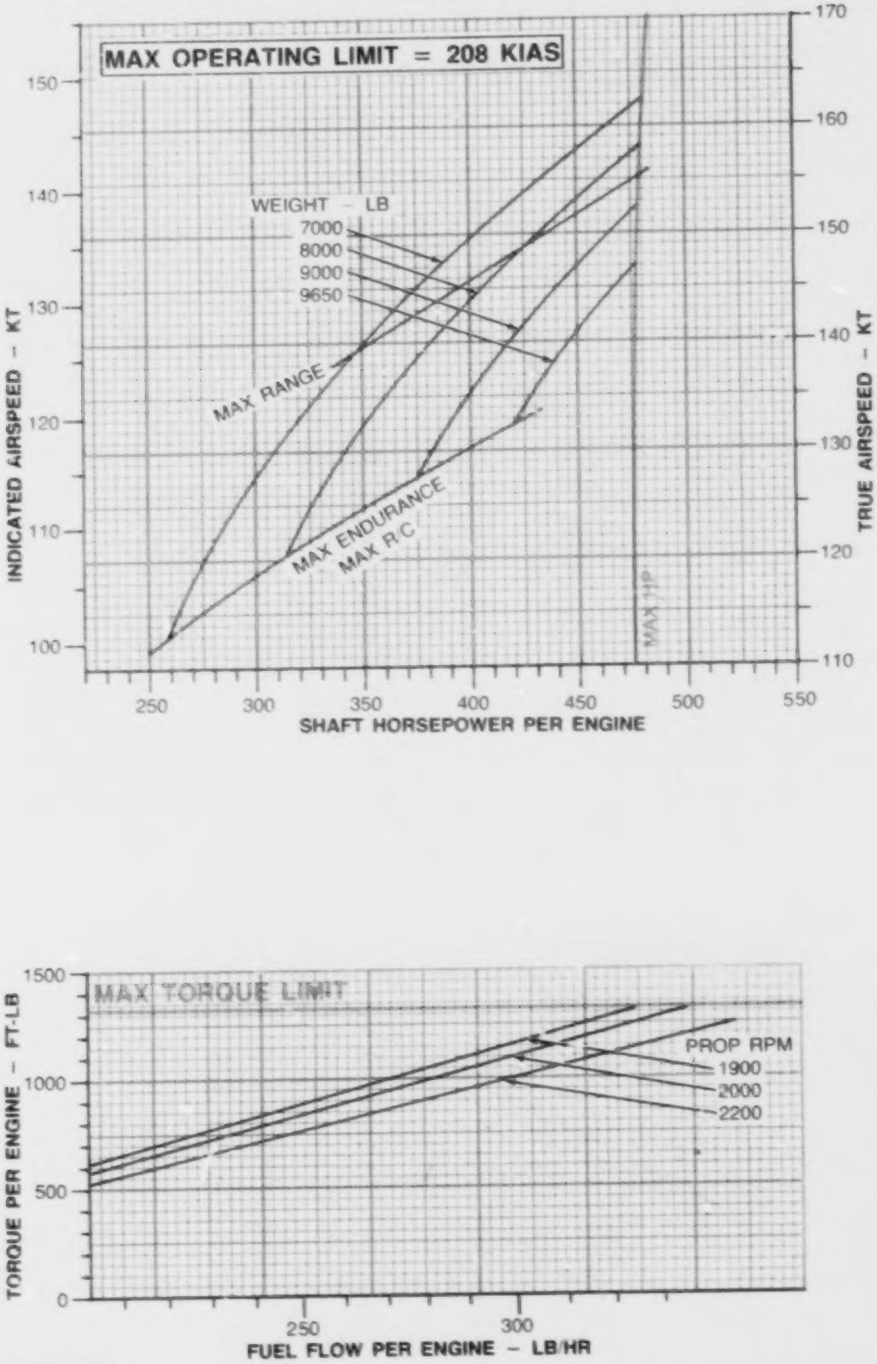
AP 004033.1

Figure 7-30. Cruise FAT 20°C, 4000 Ft (Sheet 1 of 2)

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 20°C



DATA BASIS: ESTIMATED

AP 004033.2

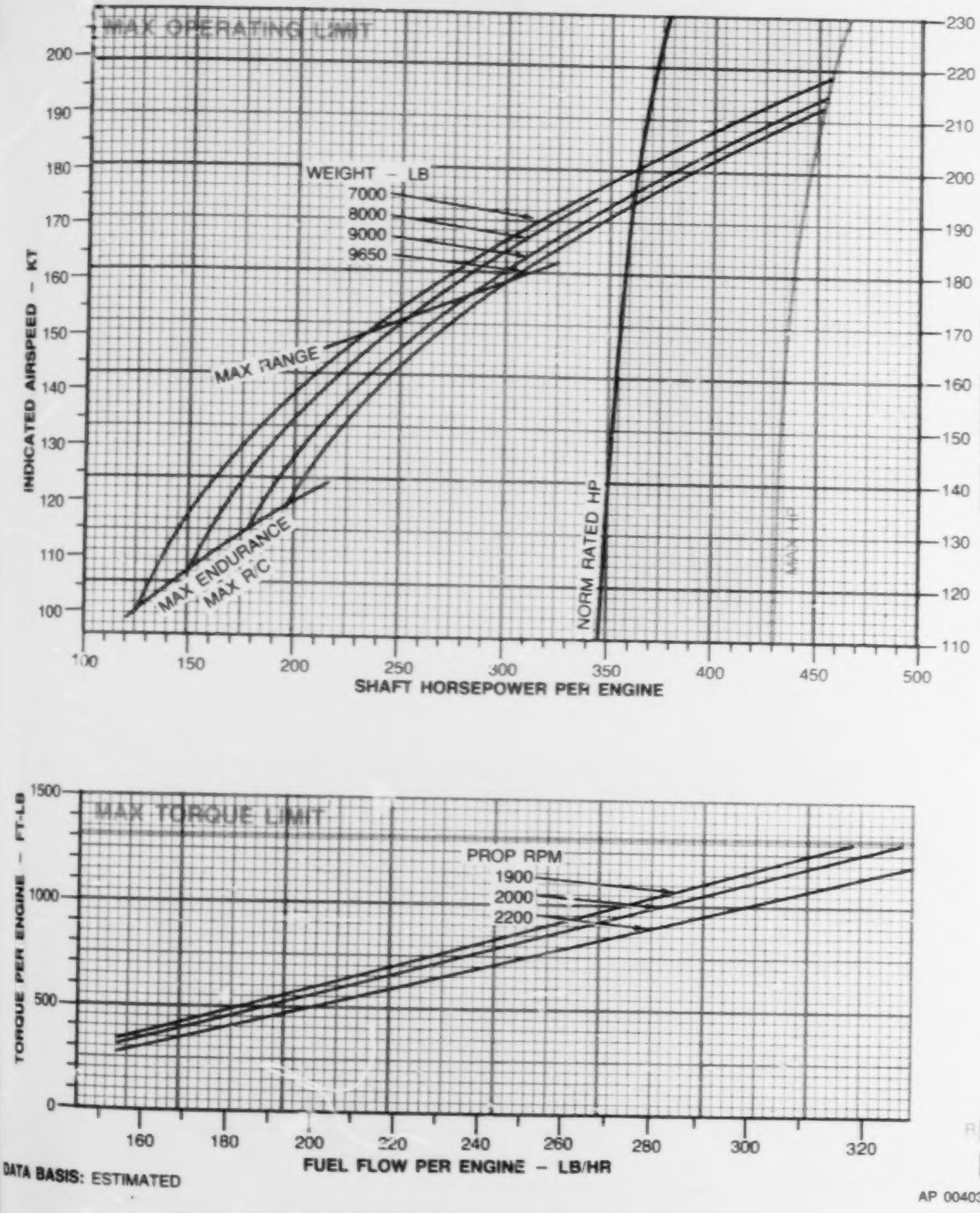
Figure 7-30. Cruise FAT 20°C, 4000 Ft (Sheet 2 of 2)

CRUISE
U-21A
T74-CP-700

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 30°C



DATA BASIS: ESTIMATED

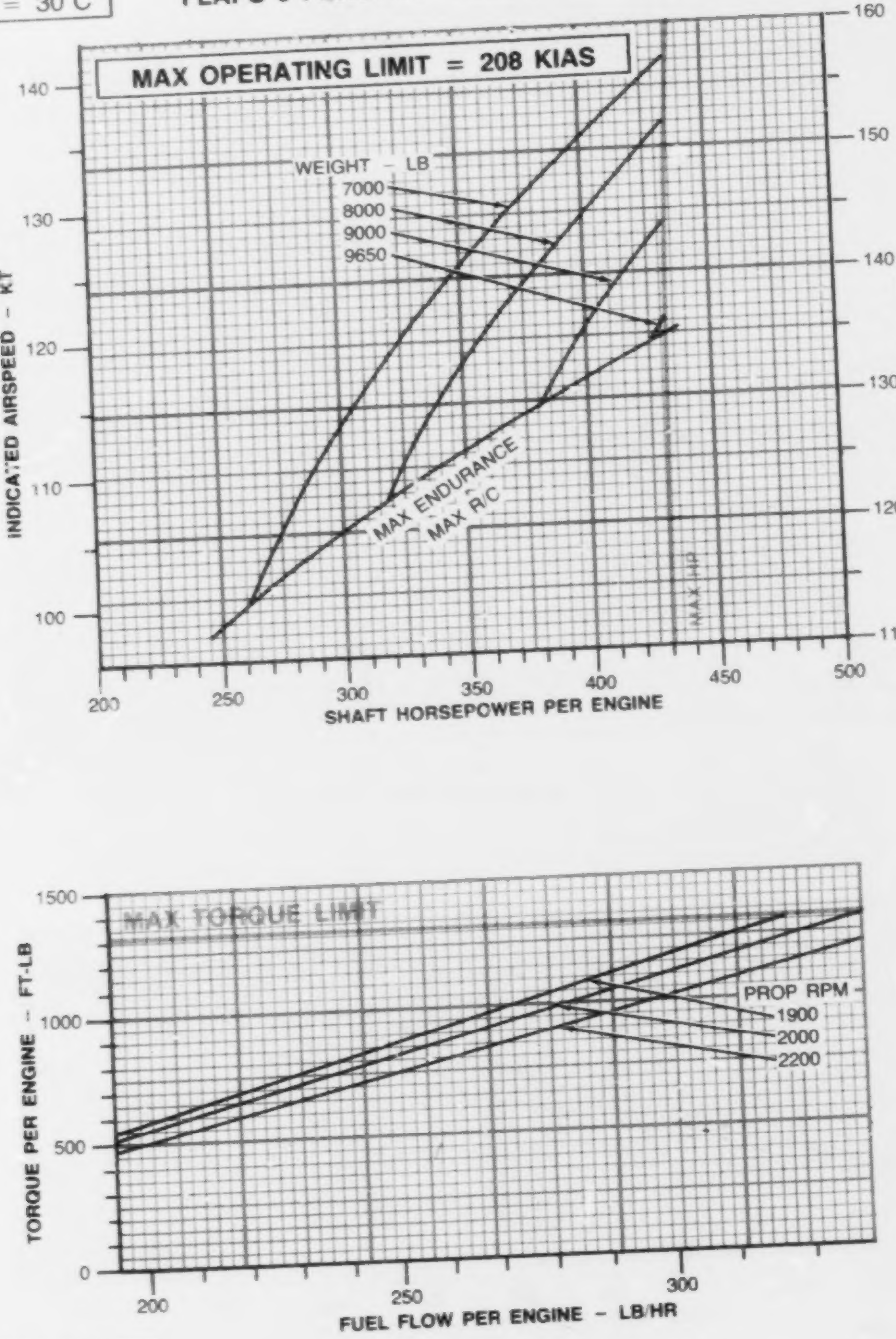
AP 004034.1

Figure 7-31. Cruise FAT 30°C, 4000 Ft (Sheet 1 of 2)

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 30°C



DATA BASIS: ESTIMATED

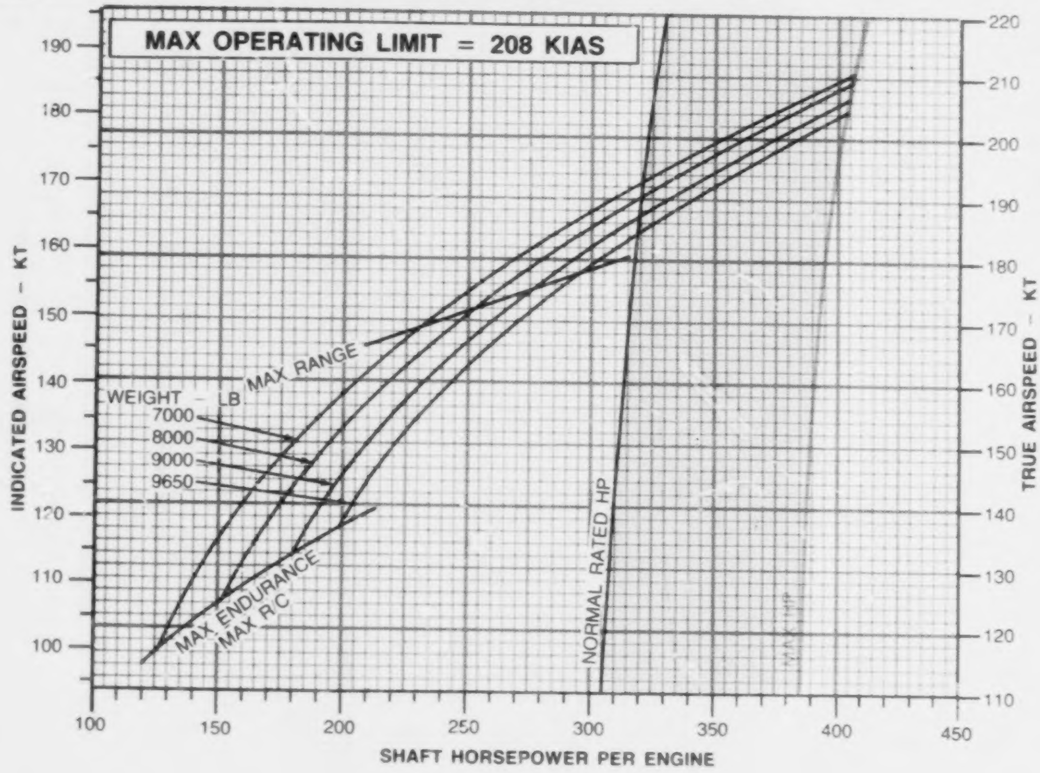
Figure 7-31. Cruise FAT 30°C, 4000 Ft (Sheet 2 of 2)

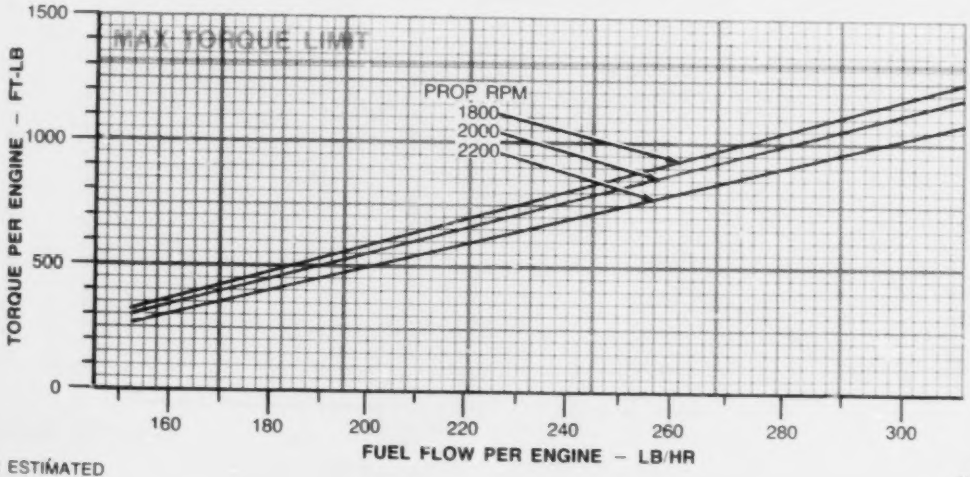
CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 4000 FT
FLAPS 0 PERCENT FUEL JP4 GEAR UP

CRUISE
U-21A
T74-CP-700

FAT = 40°C





DATA BASIS: ESTIMATED

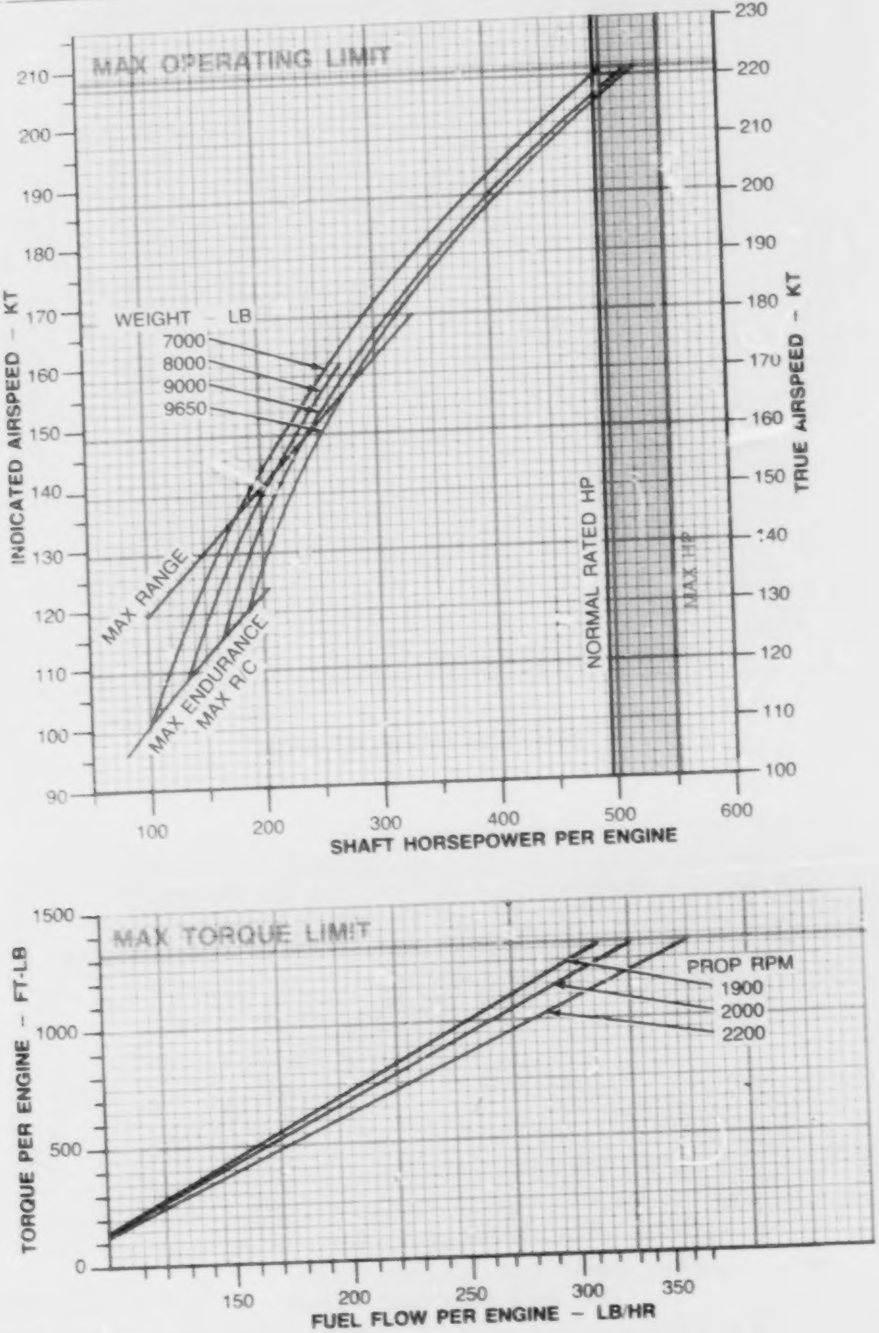
AP 004035 1

Figure 7-32. Cruise FAT 40°C, 4000 Ft

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = -30°C



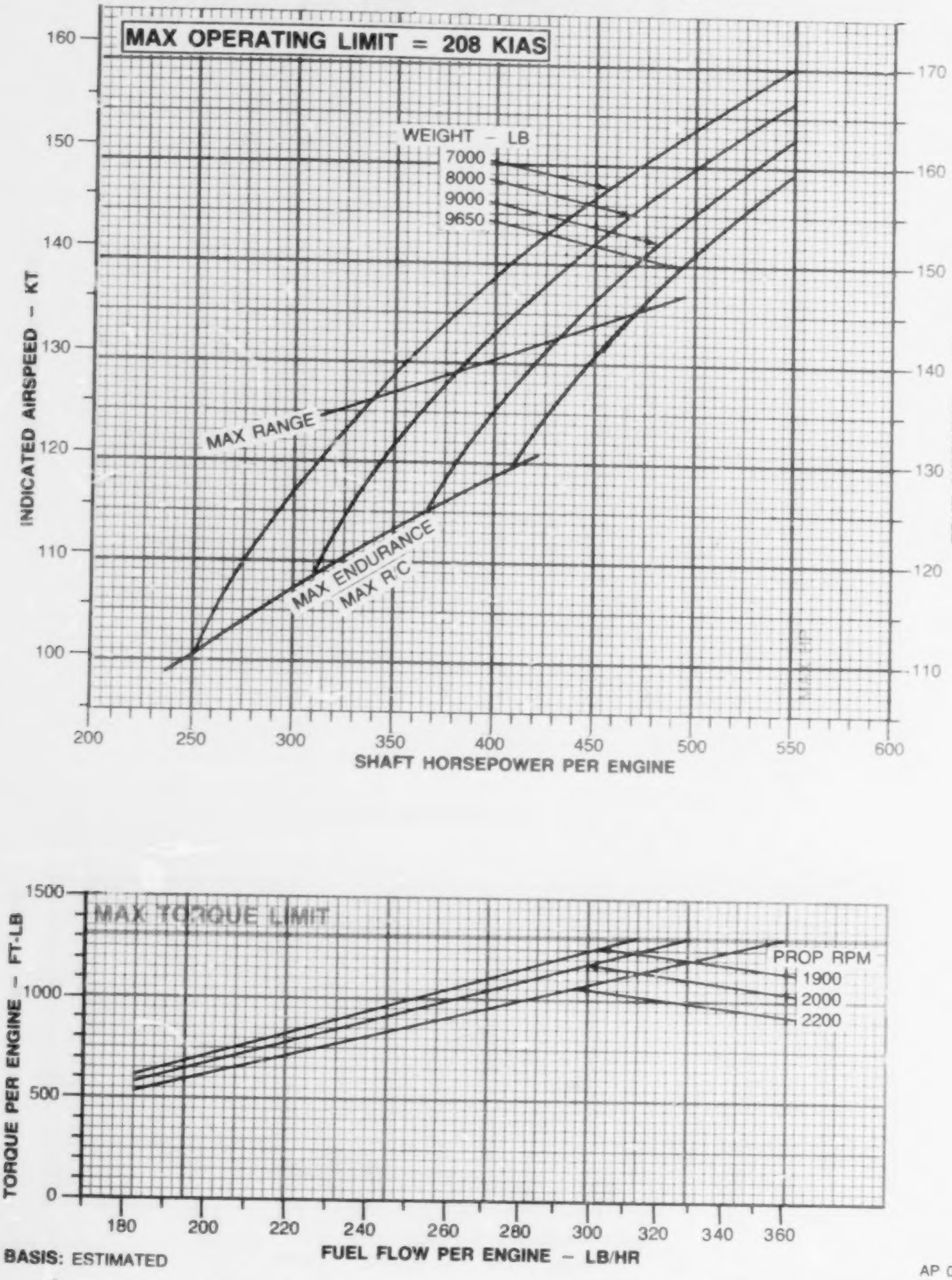
DATA BASIS: ESTIMATED

Figure 7-33. Cruise FAT -30°C, 8000 Ft (Sheet 1 of 2)

CRUISE

FAT = −30°C

SINGLE ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP



DATA BASIS: ESTIMATED

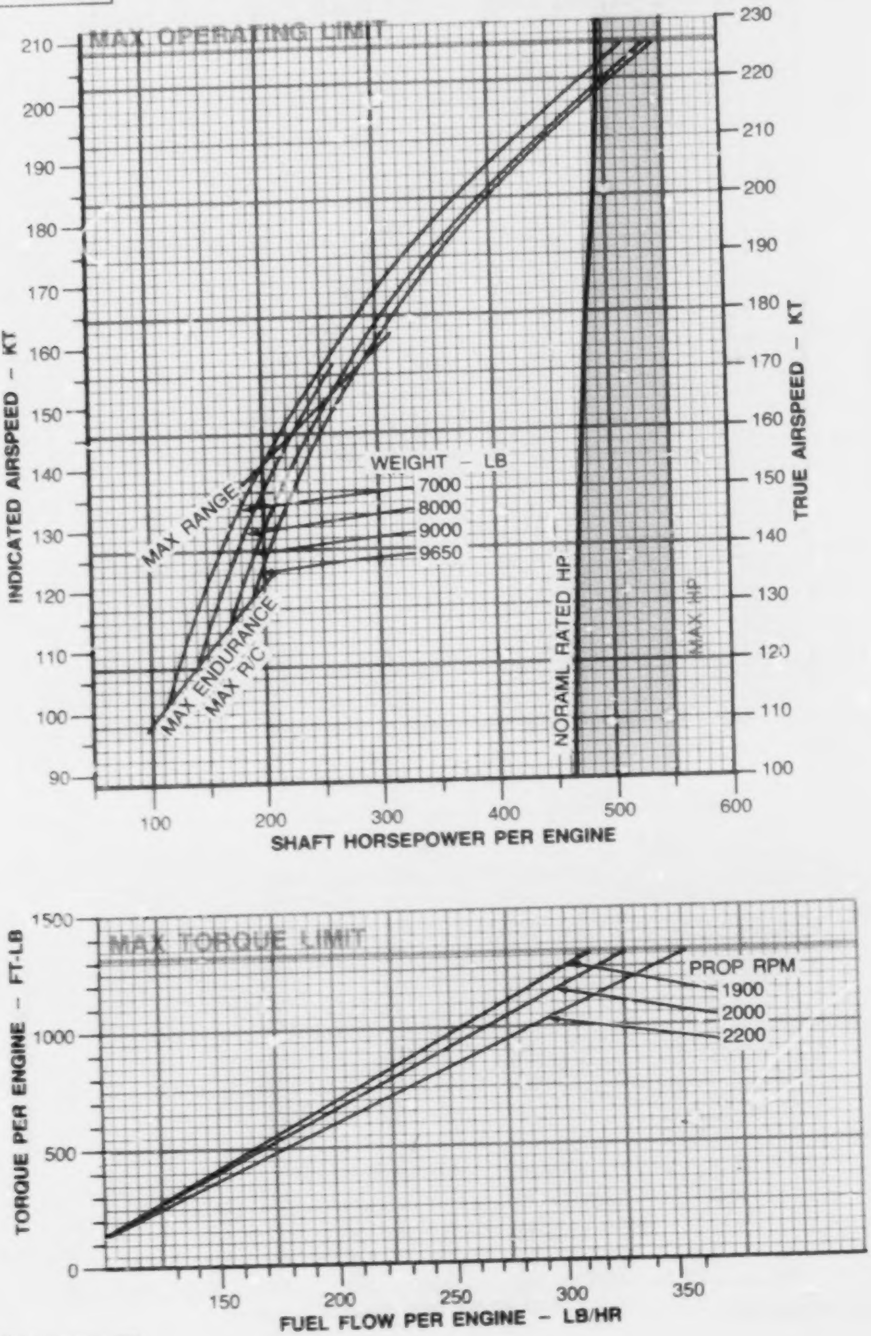
AP 004036.2

Figure 7-33. Cruise FAT -30°C, 8000 Ft (Sheet 2 of 2)

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = -20°C



AP 004037.1

DATA BASIS: ESTIMATED

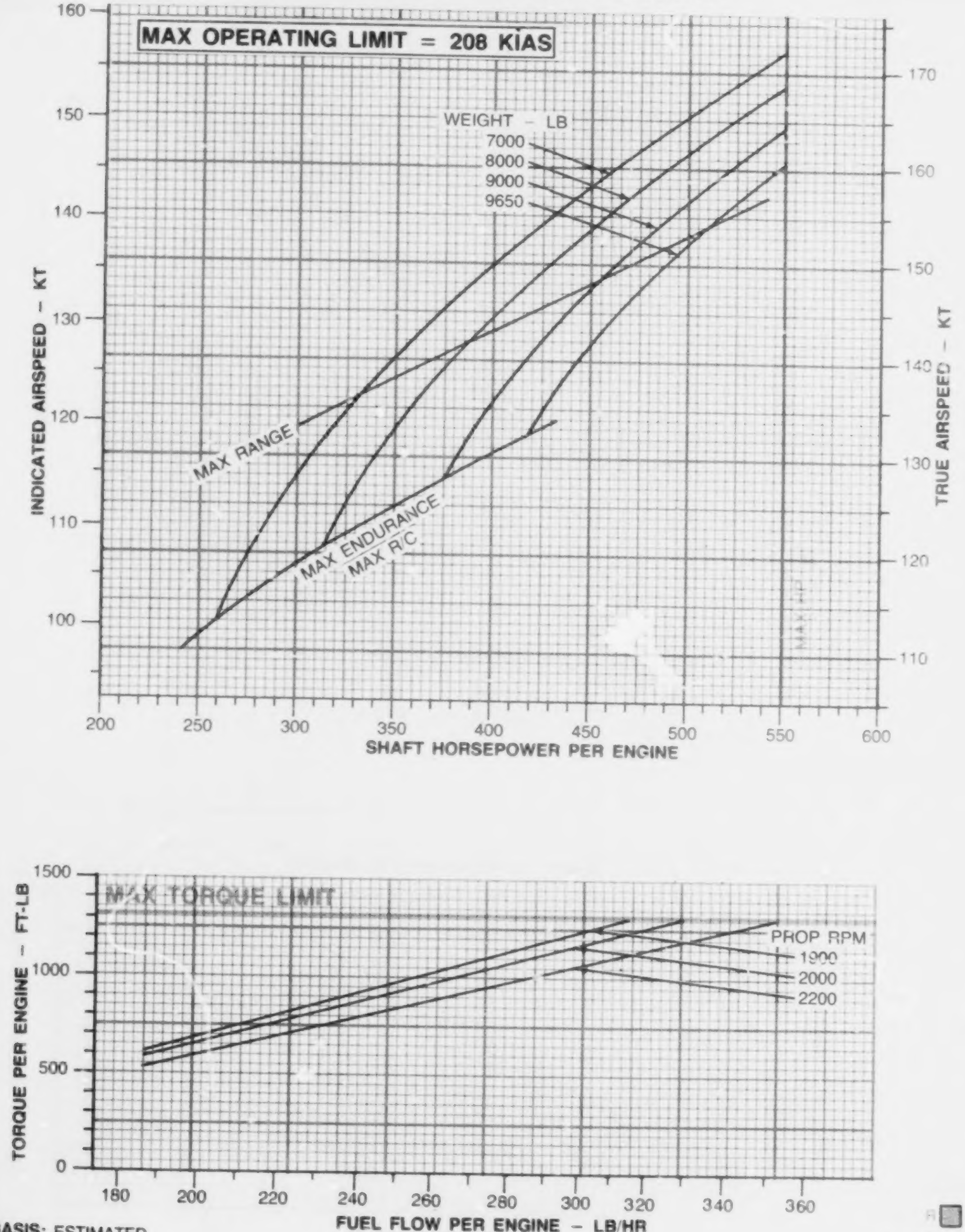
Figure 7-34. Cruise FAT -20°C, 8000 Ft (Sheet 1 of 2)

CRUISE
U-21A
T74-CP-700

FAT = -20°C

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP



DATA BASIS: ESTIMATED

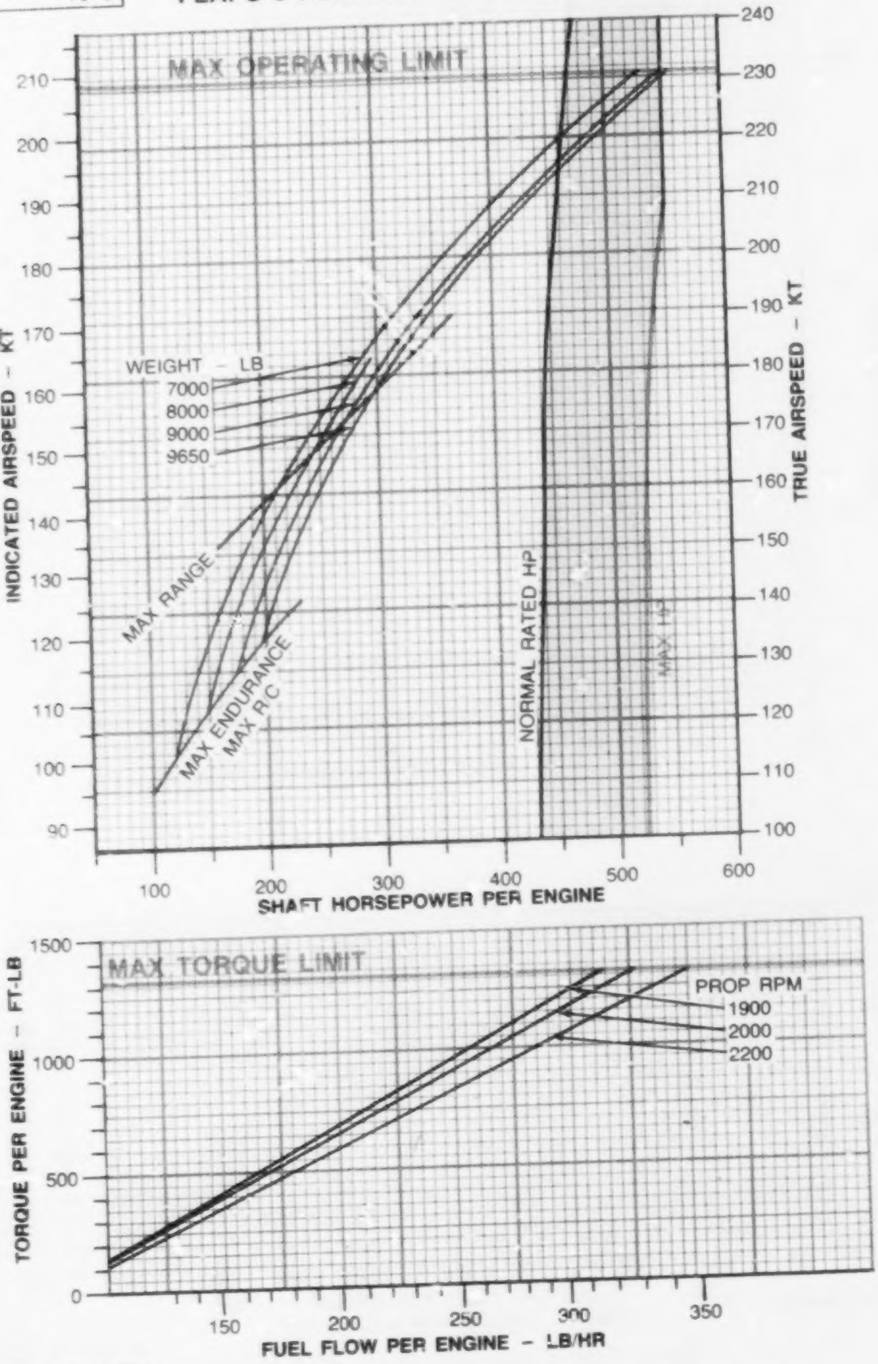
AP 004037.2

Figure 7-34. Cruise FAT -20°C, 8000 Ft (Sheet 2 of 2)

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −10°C



AP 004038 1

DATA BASIS: ESTIMATED

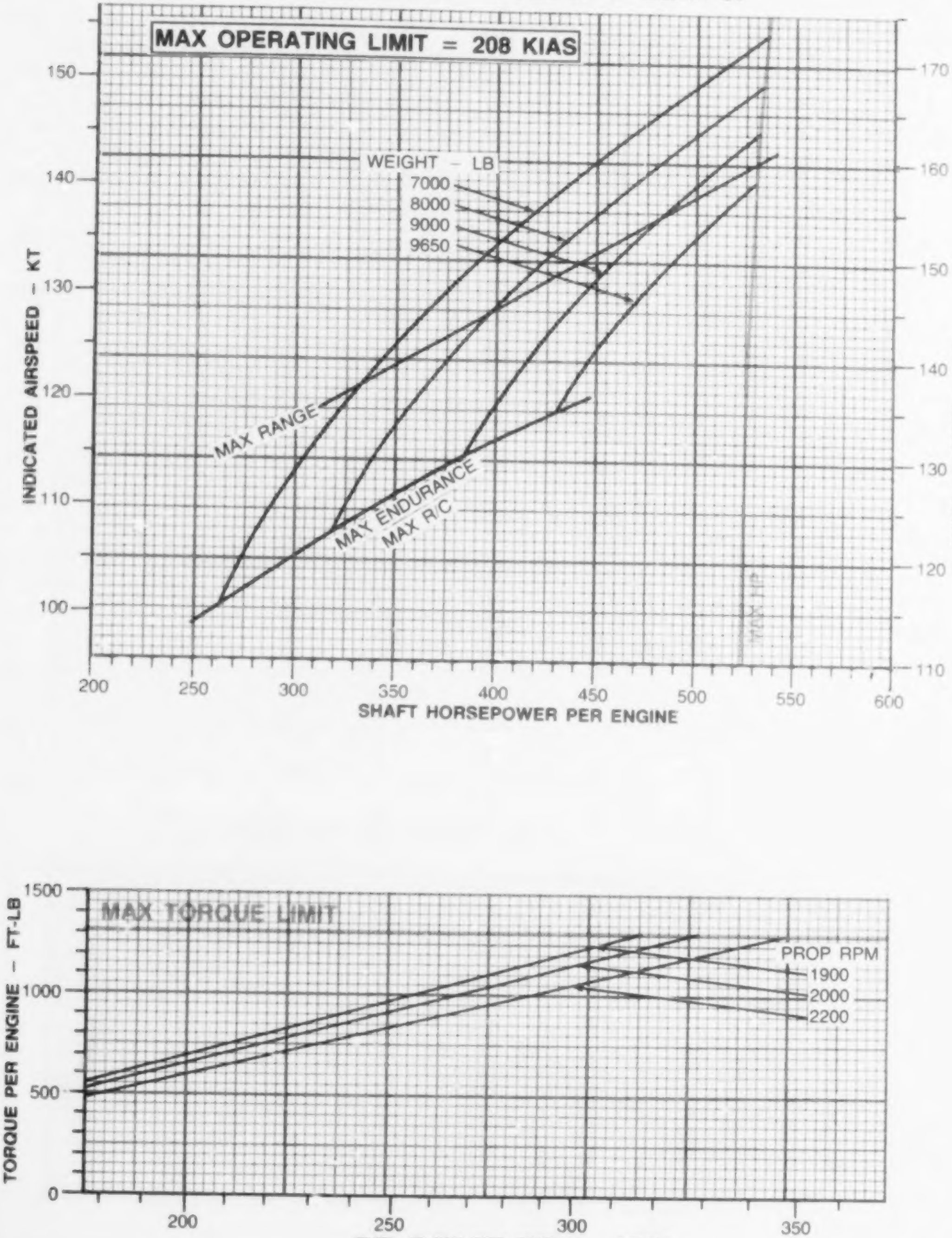
Figure 7-35. Cruise FAT -10°C, 8000 Ft (Sheet 1 of 2)

CRUISE

CRUISE
U-21A
T74-CP-700

SINGLE ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −10°C



DATA BASIS: ESTIMATED

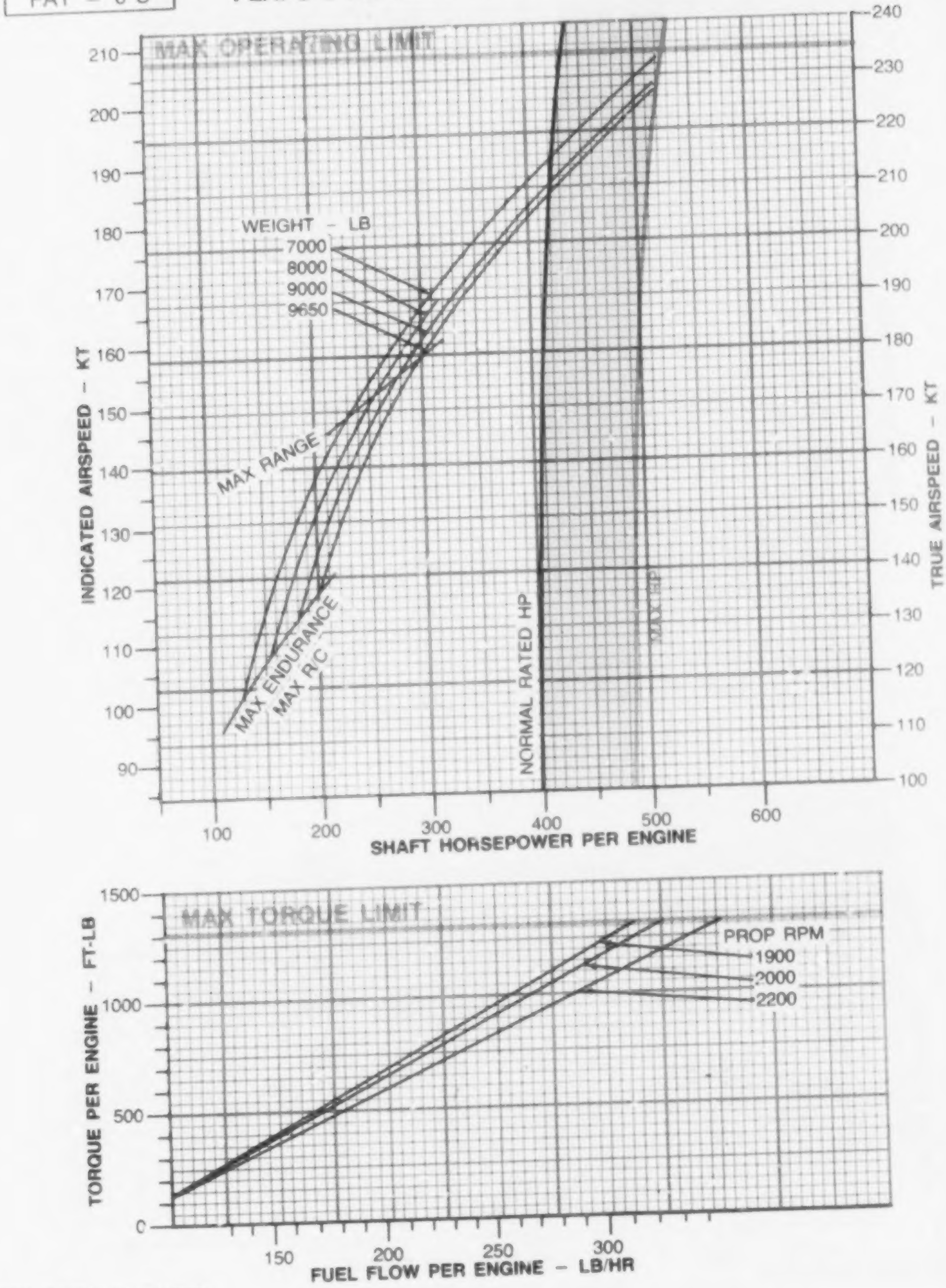
AP 004038.2

Figure 7-35. Cruise FAT -10°C, 8000 Ft (Sheet 2 of 2)

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 0°C



DATA BASIS: ESTIMATED

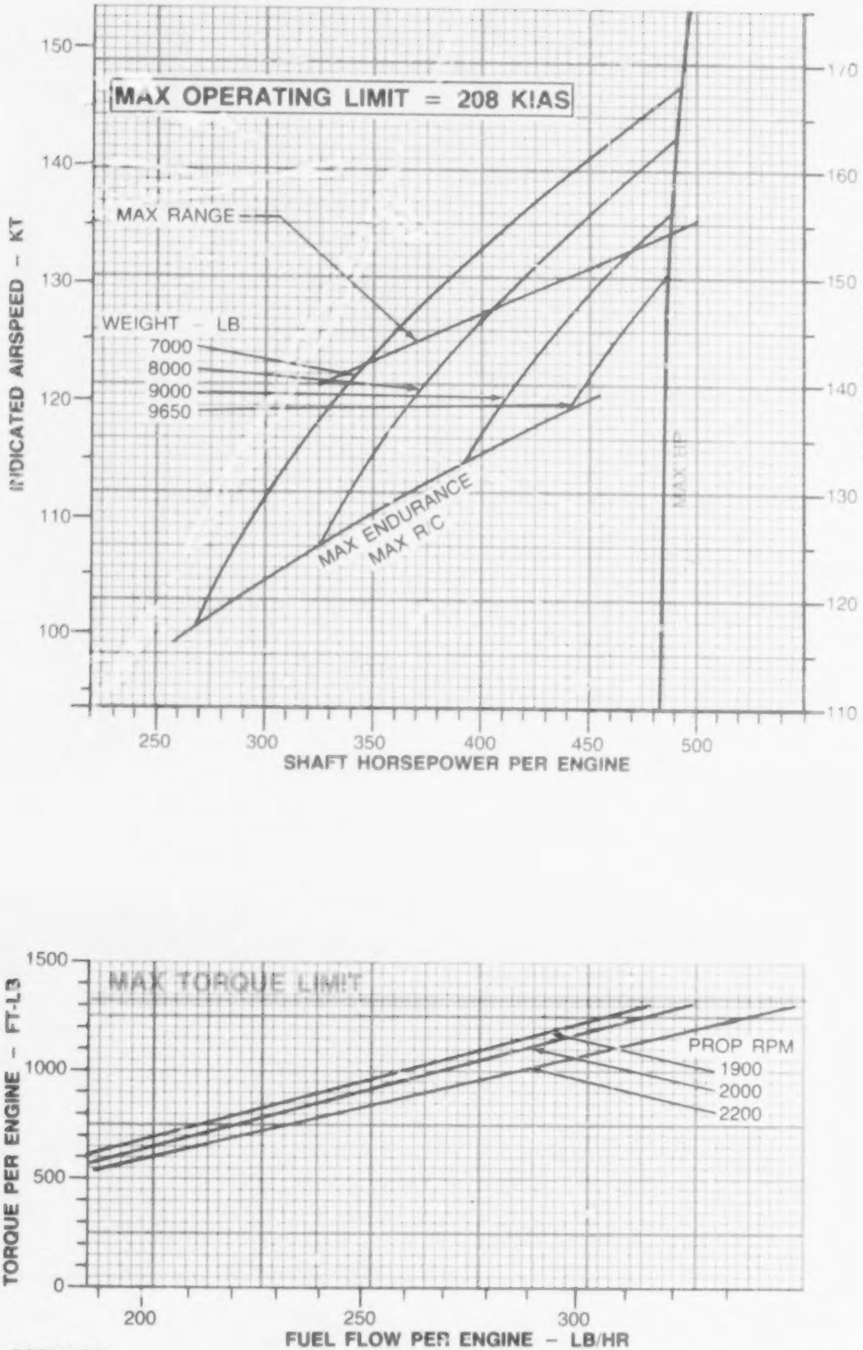
Figure 7-36. Cruise FAT 0°C, 8000 Ft (Sheet 1 of 2)

CRUISE

CRUISE
U-21A
T74-CP-700

FAT = 0°C

SINGLE ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP



DATA BASIS: ESTIMATED

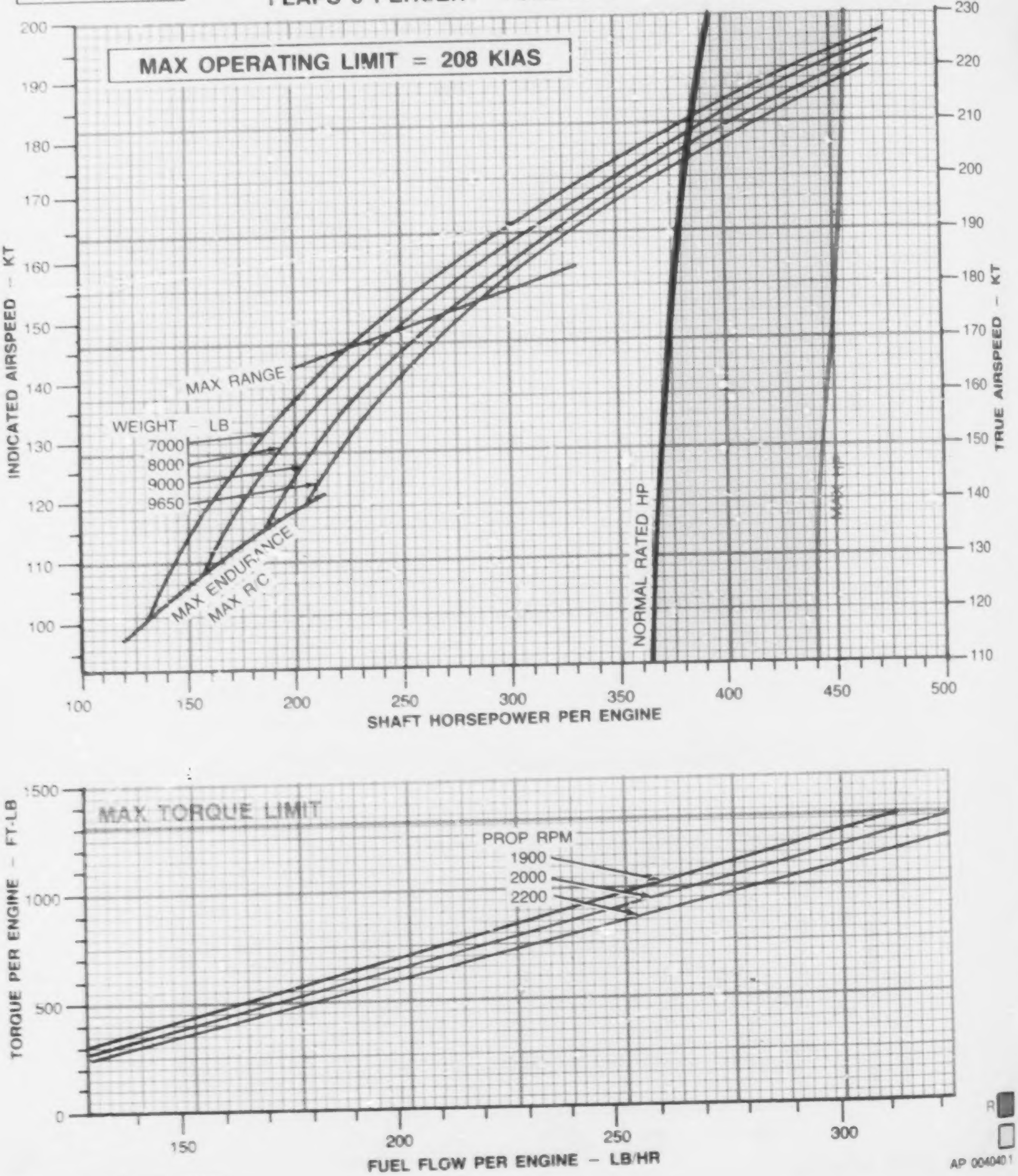
AP 004039 2

Figure 7-36. Cruise FAT 0°C, 8000 Ft (Sheet 2 of 2)

CRUISE
U-21A
T74-CP-700

CRUISE
TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 10°C



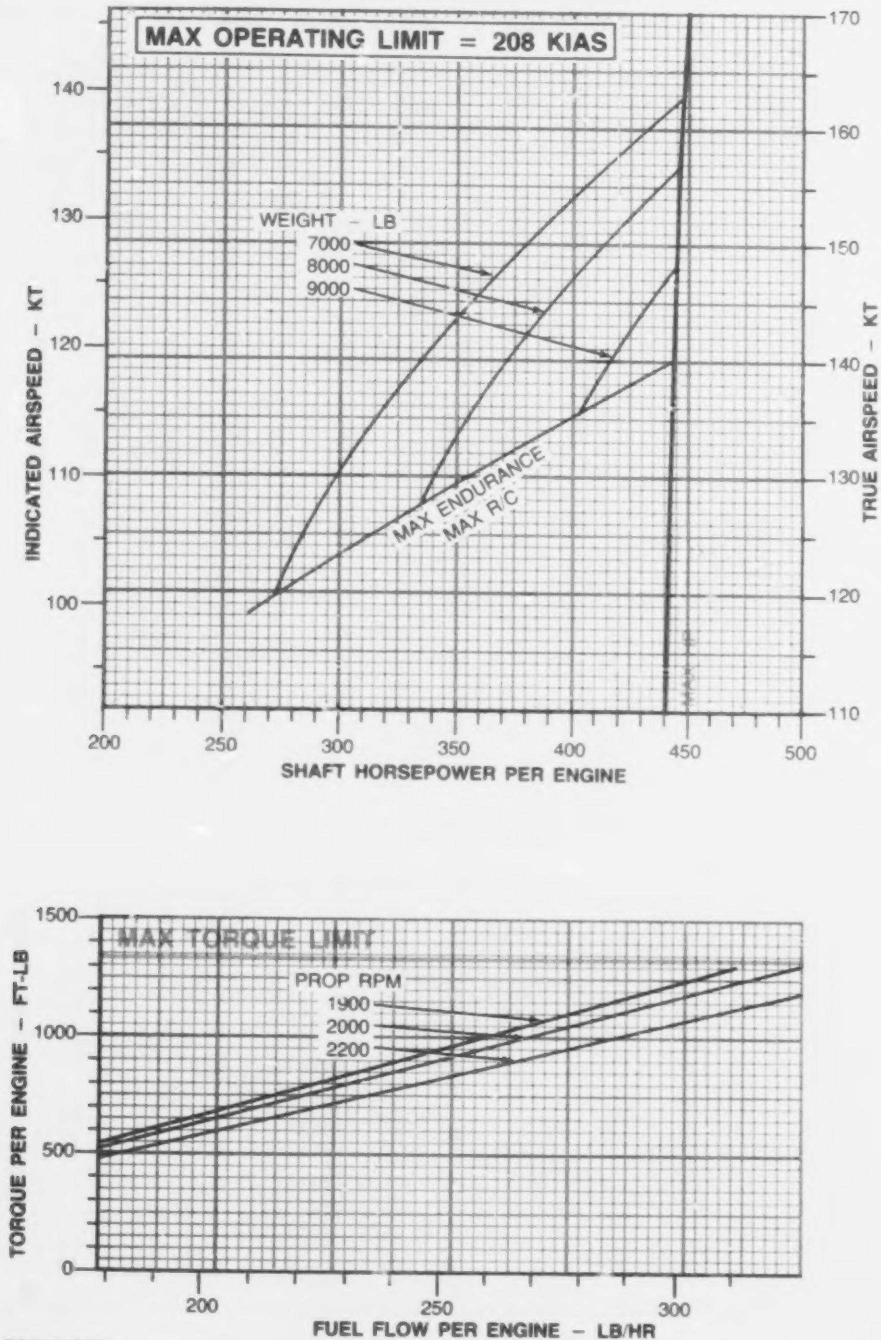
DATA BASIS: ESTIMATED

Figure 7-37. Cruise FAT 10°C, 8000 Ft (Sheet 1 of 2)

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 10°C



DATA BASIS: ESTIMATED

AP 004040.2

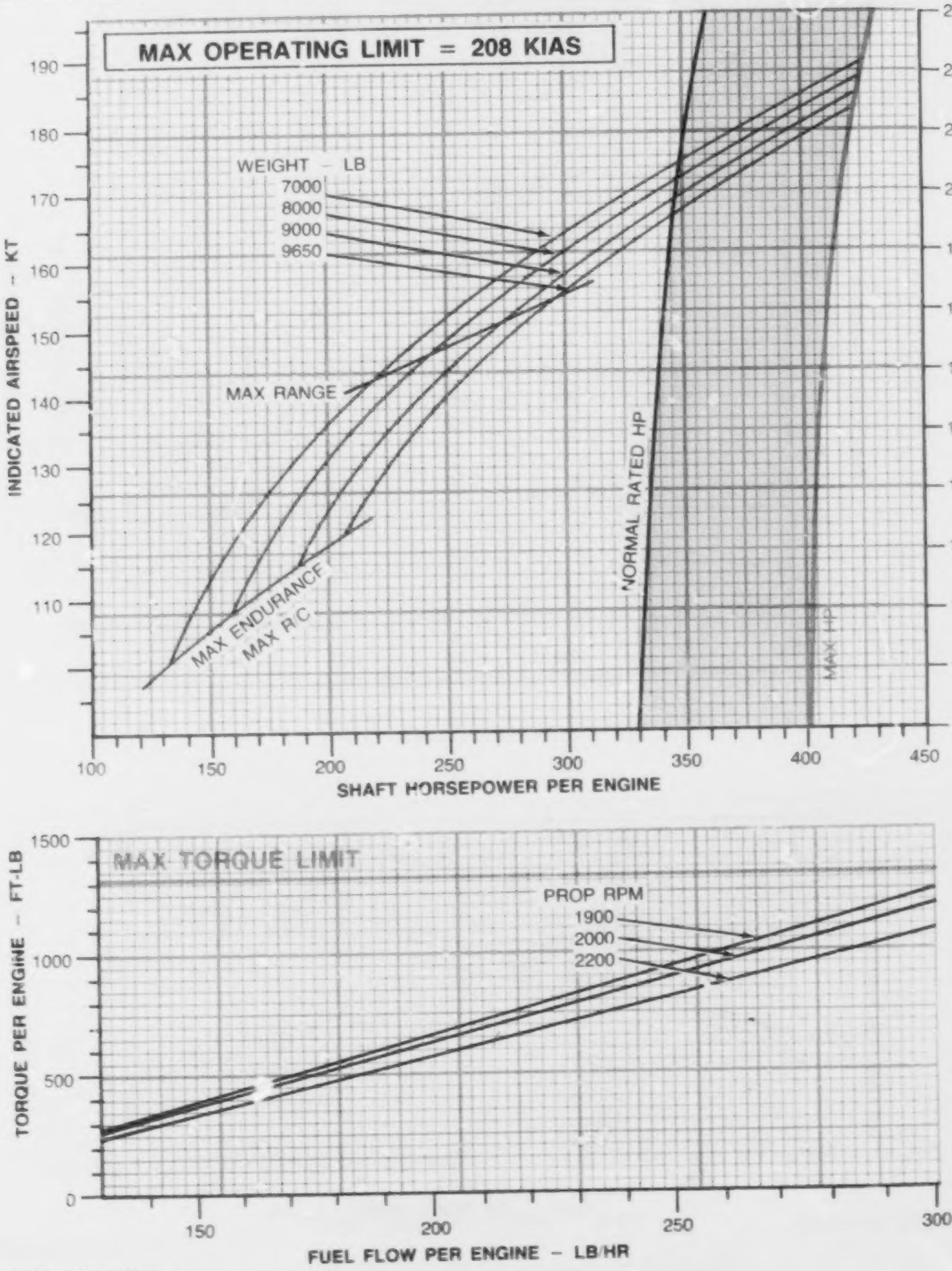
Figure 7-37. Cruise FAT 10°C, 8000 Ft (Sheet 2 of 2)

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 20°C

CRUISE
U-21A
T74-CP-700



DATA BASIS: ESTIMATED

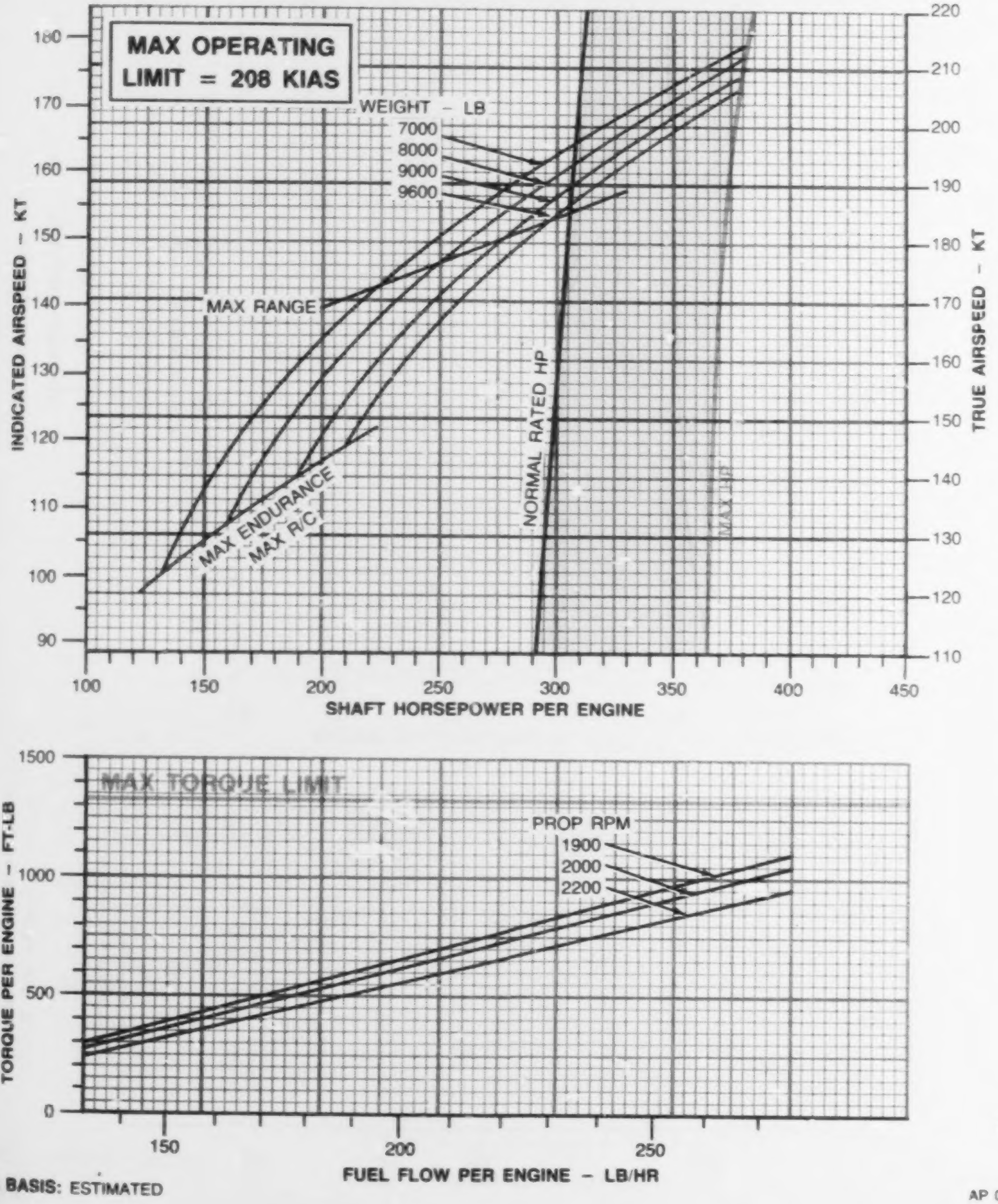
Figure 7-38. Cruise FAT 20°C, 8000 Ft

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
U-21A
T74-CP-700

FAT = 30°C



DATA BASIS: ESTIMATED

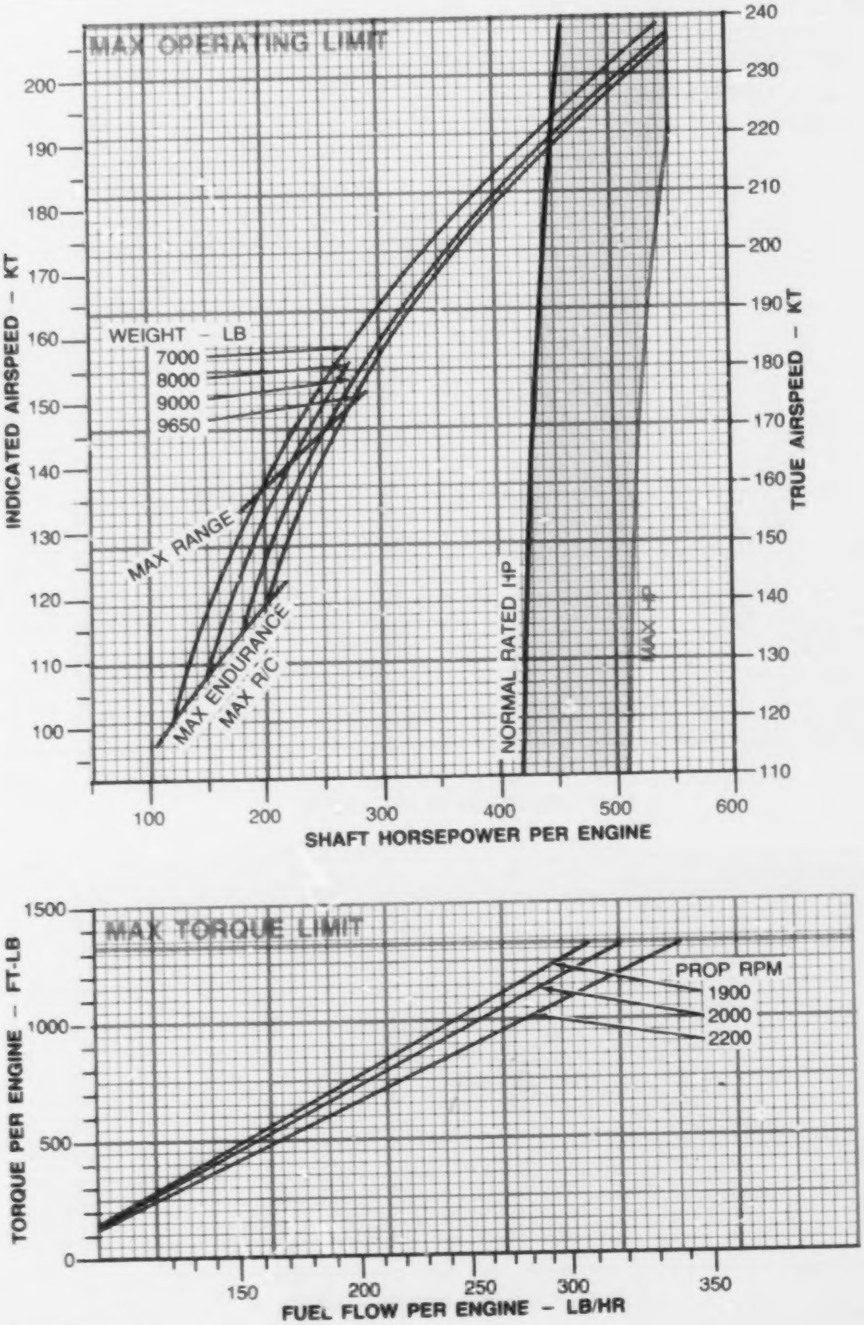
AP 004042

Figure 7-39. Cruise FAT 30°C, 8000 Ft

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −30°C



AP 004043.1

DATA BASIS: ESTIMATED

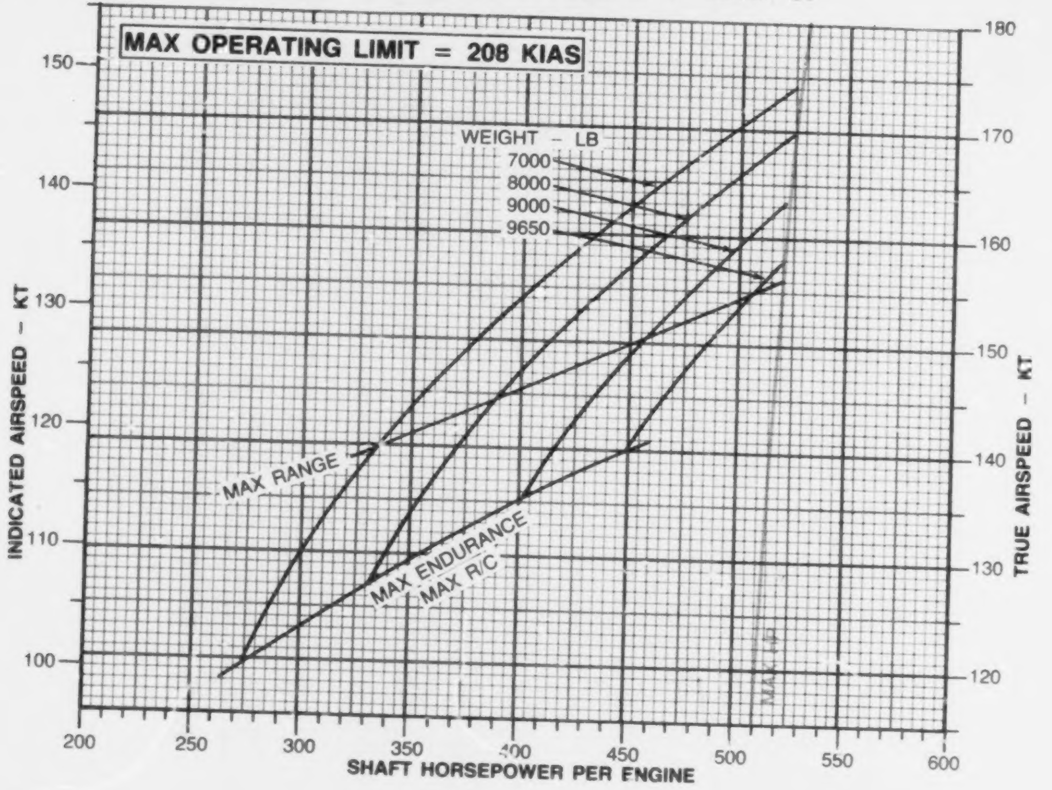
Figure 7-40. Cruise FAT -30°C, 12,000 Ft (Sheet 1 of 2)

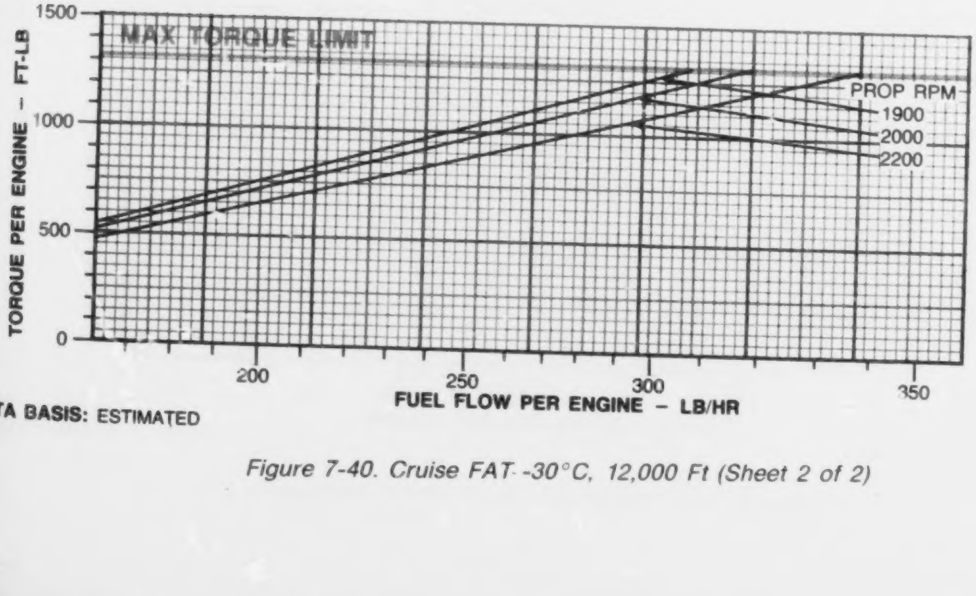
CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −30°C

CRUISE
U-21A
T74-CP-700





DATA BASIS: ESTIMATED

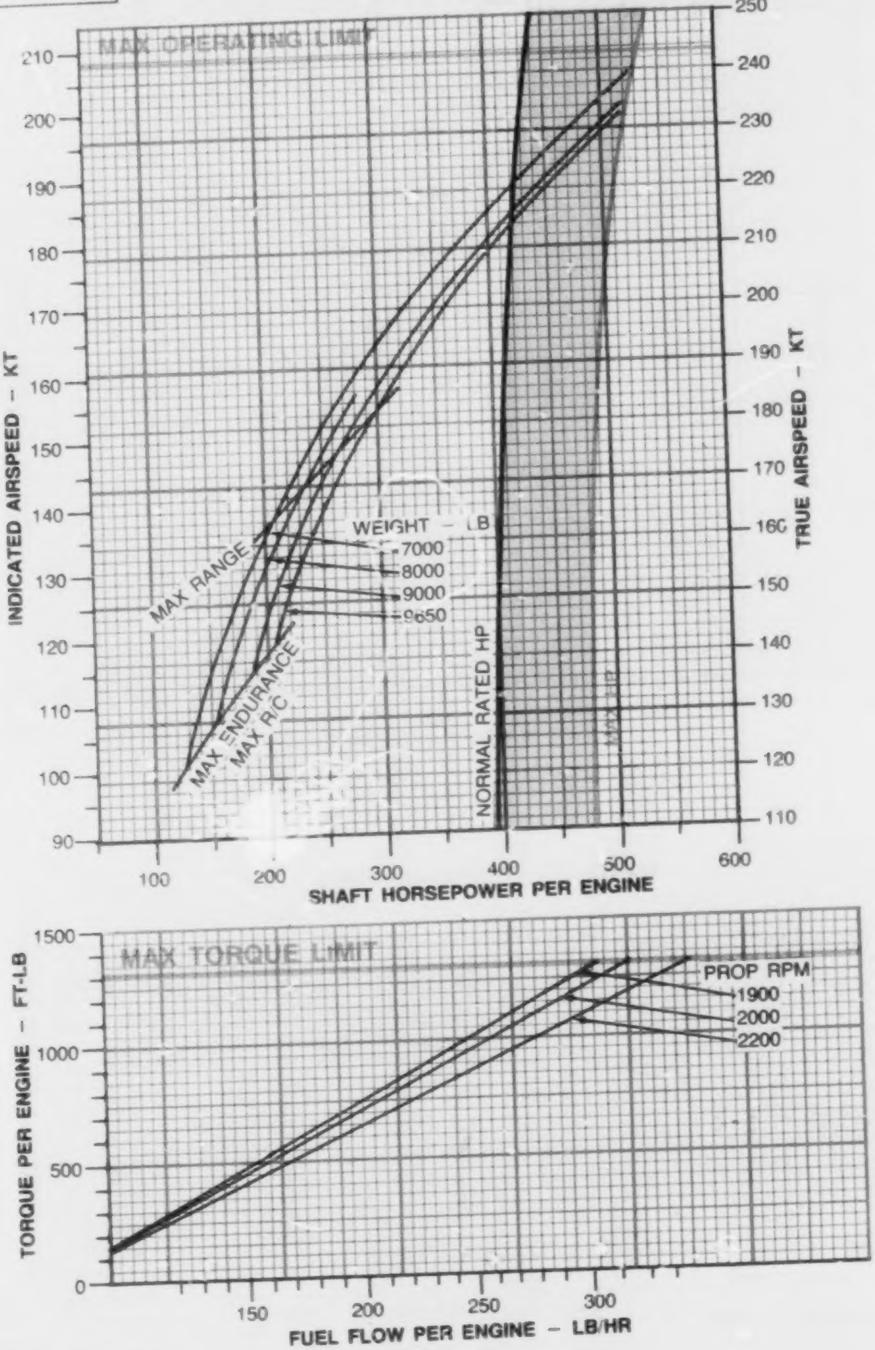
AP 004043.2

Figure 7-40. Cruise FAT -30°C, 12,000 Ft (Sheet 2 of 2)

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −20°C



AP 004044.1

DATA BASIS: ESTIMATED

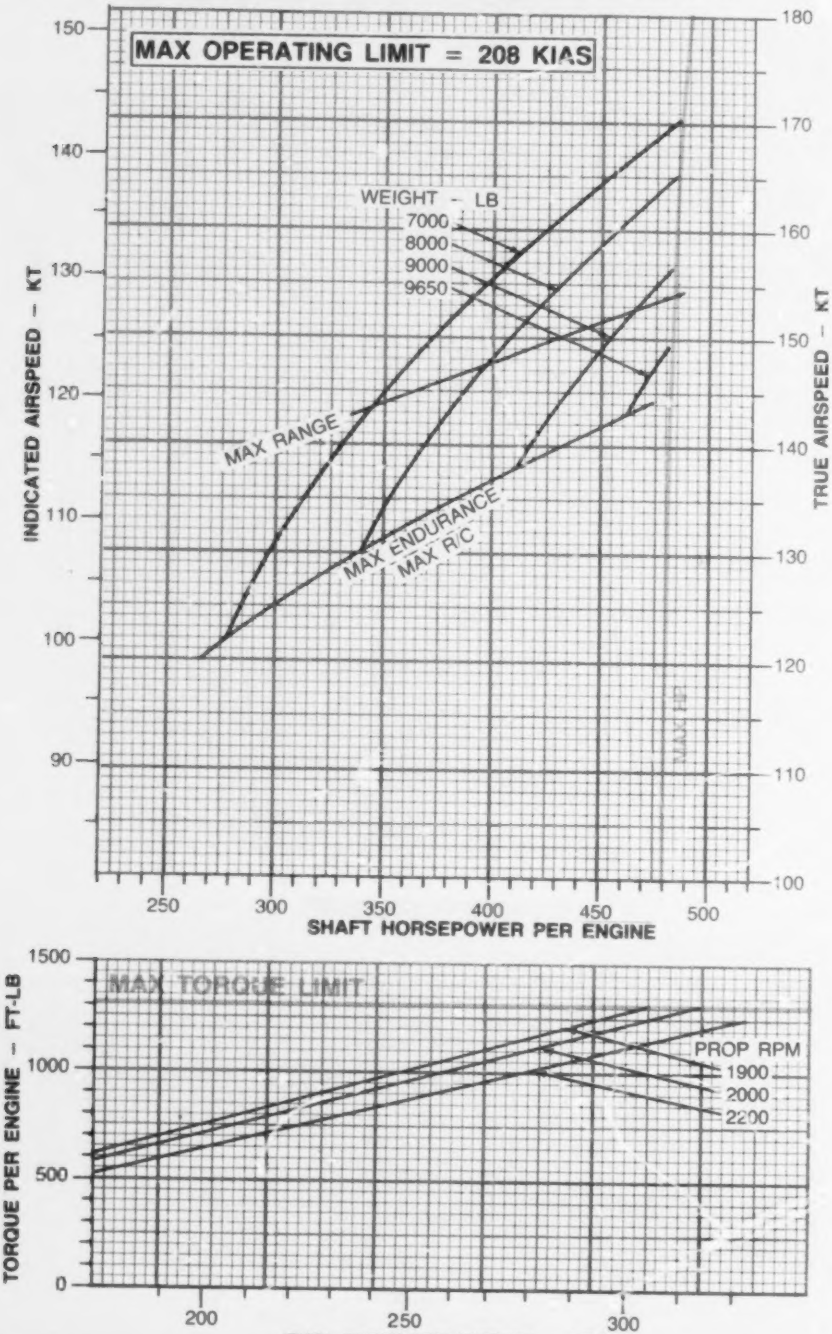
Figure 7-41. Cruise FAT -20°C, 12,000 Ft (Sheet 1 of 2)

CRUISE

CRUISE
U-21A
T74-CP-700

SINGLE ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −20°C



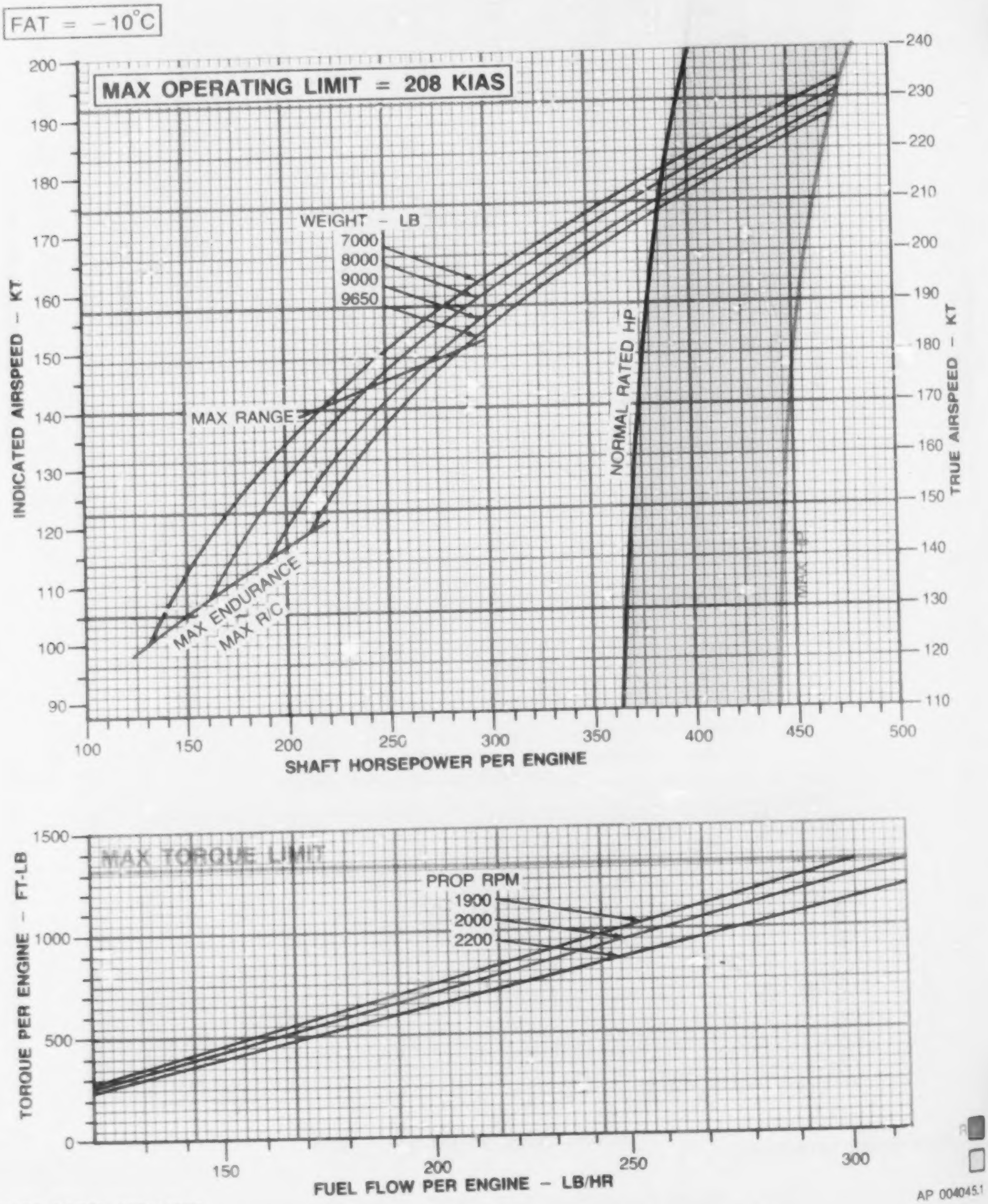
DATA BASIS: ESTIMATED

AP 004044 2

Figure 7-41. Cruise FAT -20°C, 12,000 Ft (Sheet 2 of 2)

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP



DATA BASIS: ESTIMATED

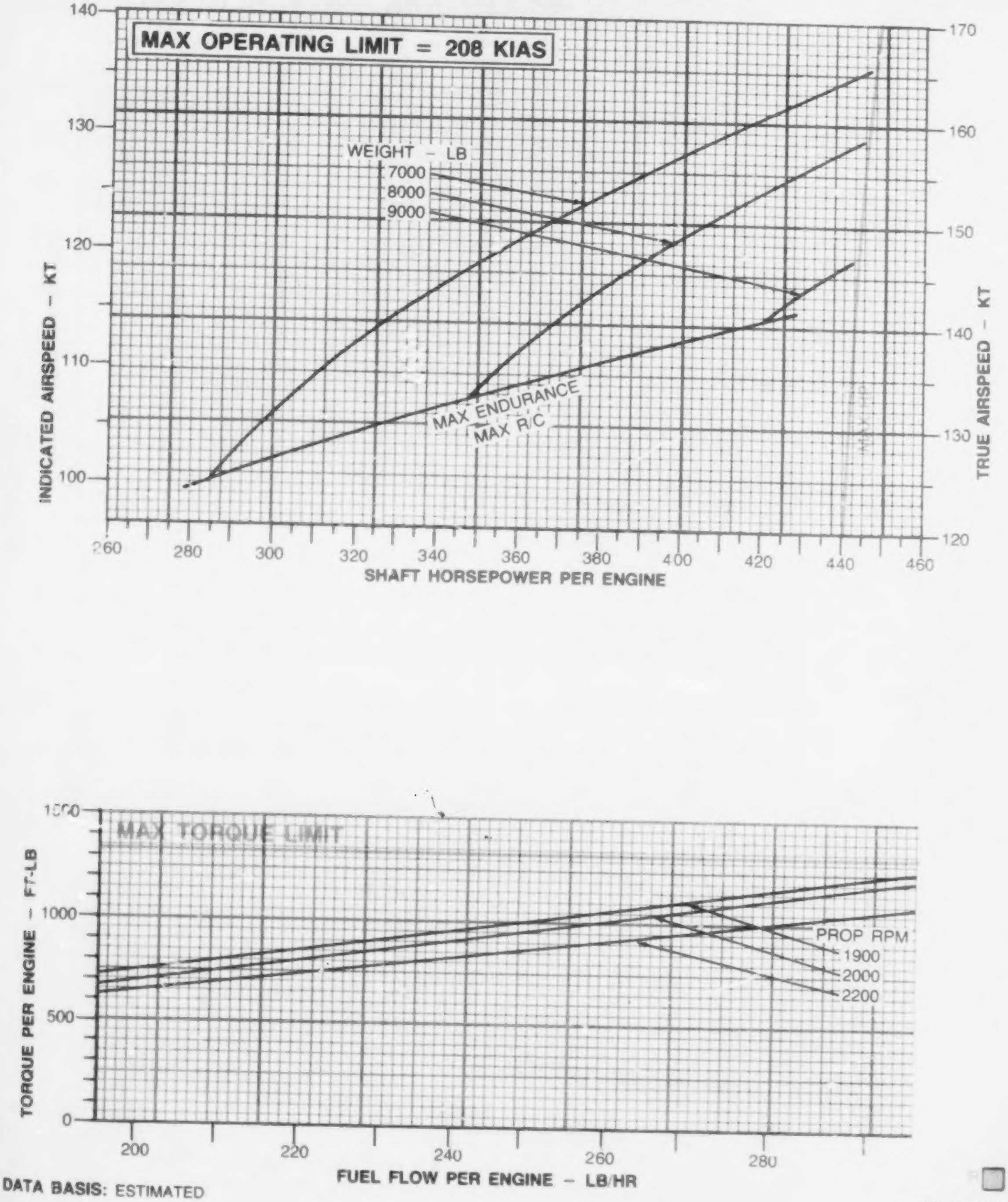
Figure 7-42. Cruise FAT -10°C, 12,000 Ft (Sheet 1 of 2)

CRUISE

CRUISE
U-21A
T74-CP-700

SINGLE ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −10°C



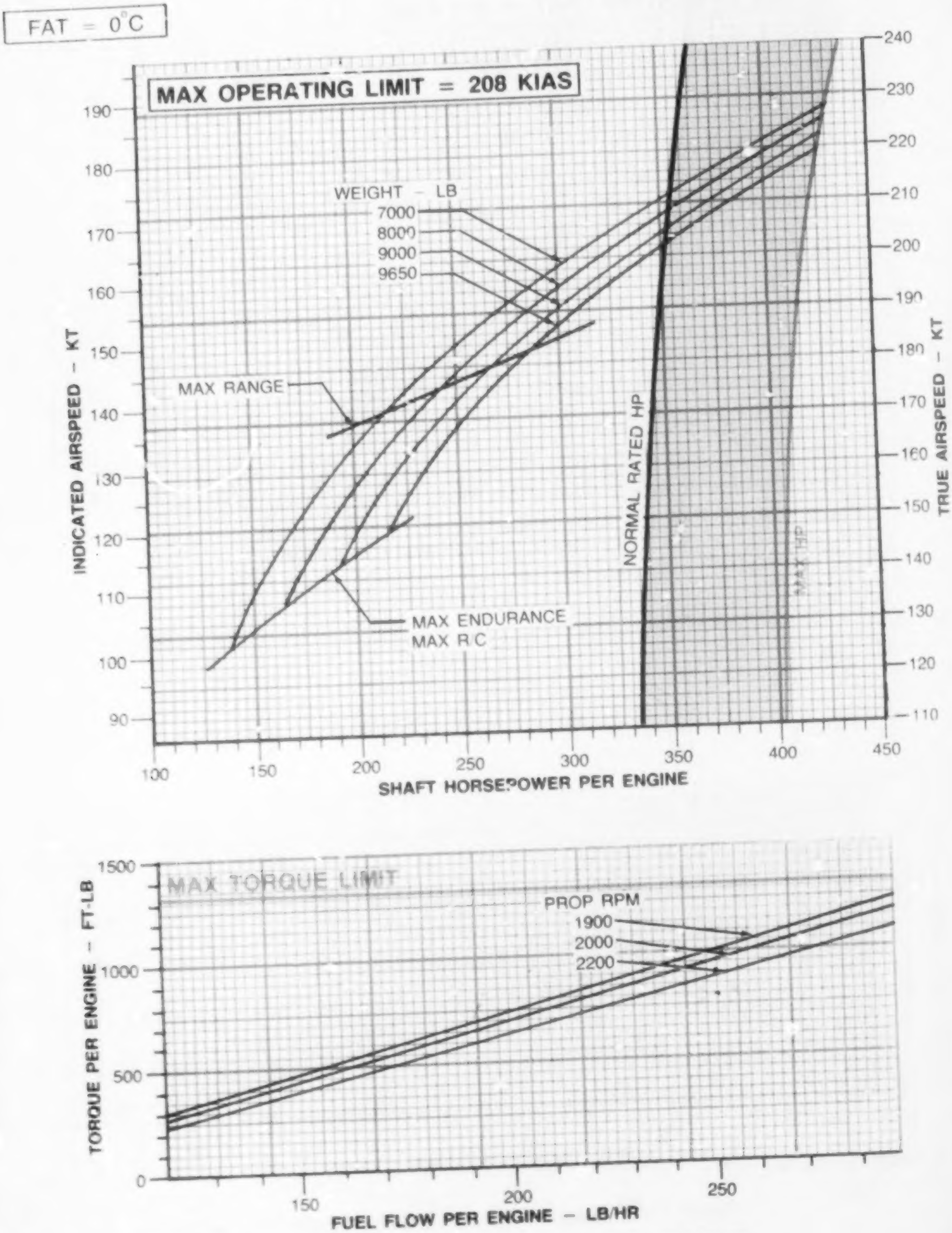
DATA BASIS: ESTIMATED

AP 004045.2

Figure 7-42. Cruise FAT -10°C, 12,000 Ft (Sheet 2 of 2)

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP



DATA BASIS: ESTIMATED

Figure 7-43. Cruise FAT 0°C, 12,000 Ft

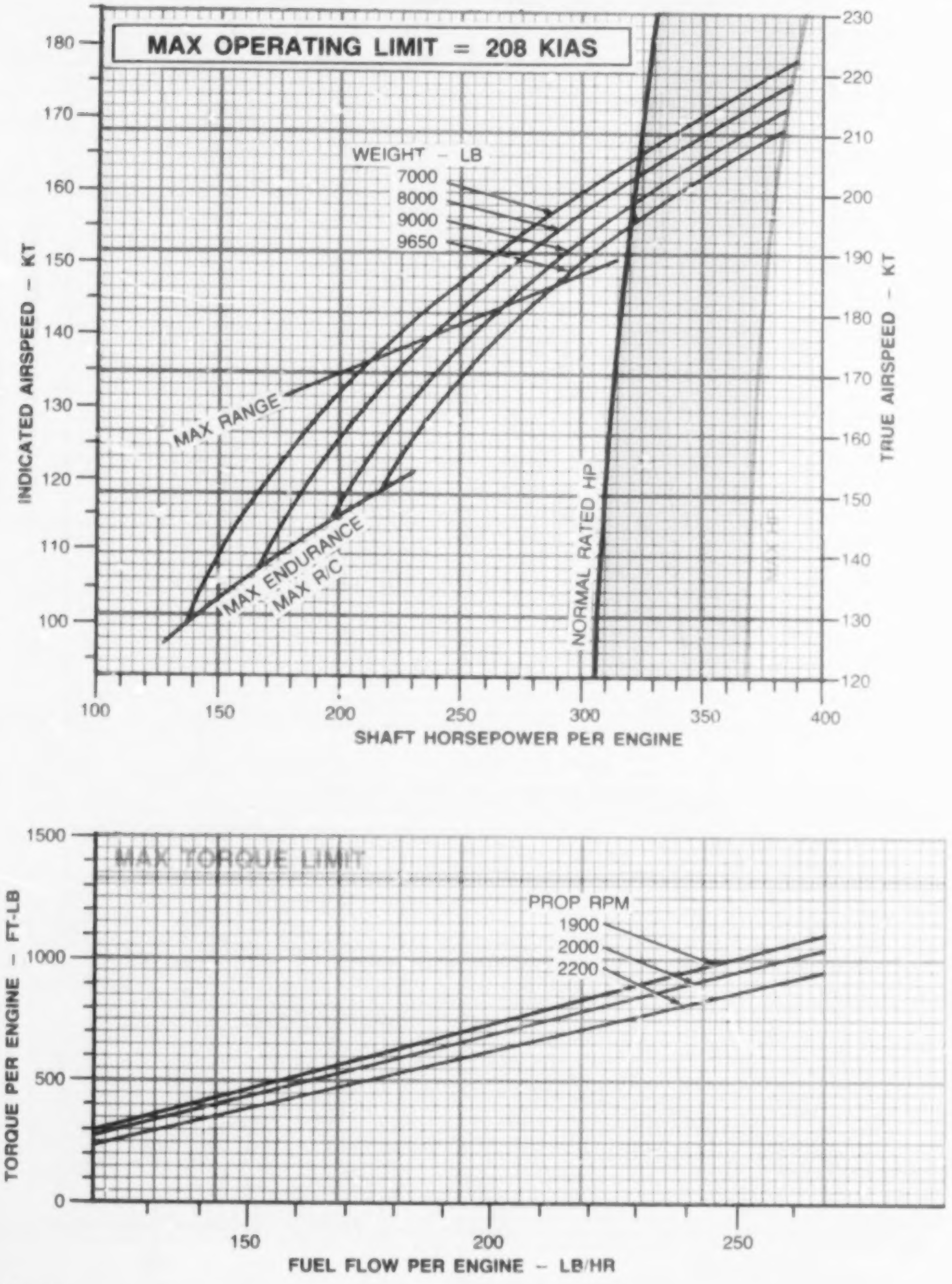
AP 004046

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 10°C

CRUISE
U-21A
T74-CP-700



DATA BASIS: ESTIMATED

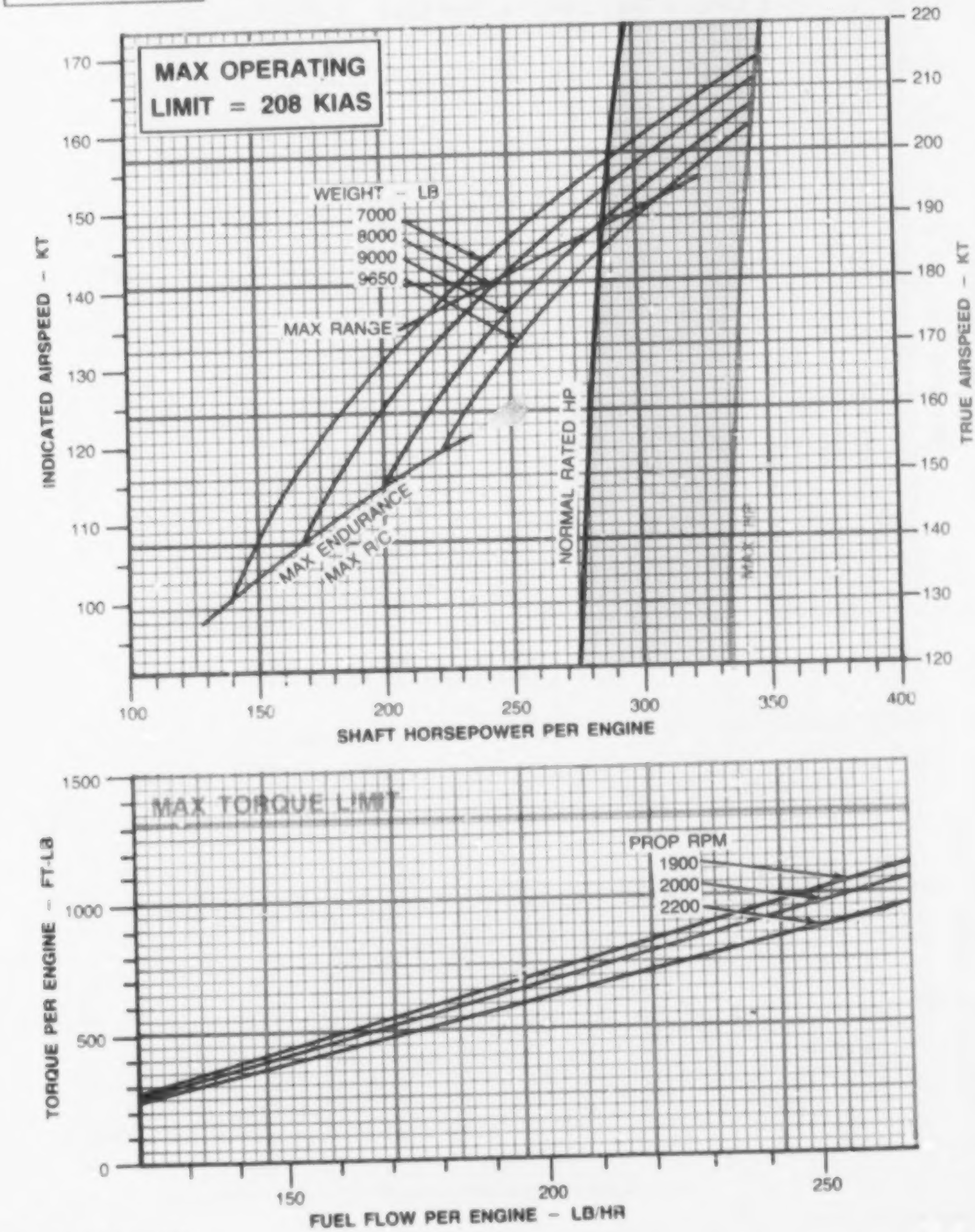
AP 004047

Figure 7-44. Cruise FAT 10°C, 12,000 Ft

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 20°C



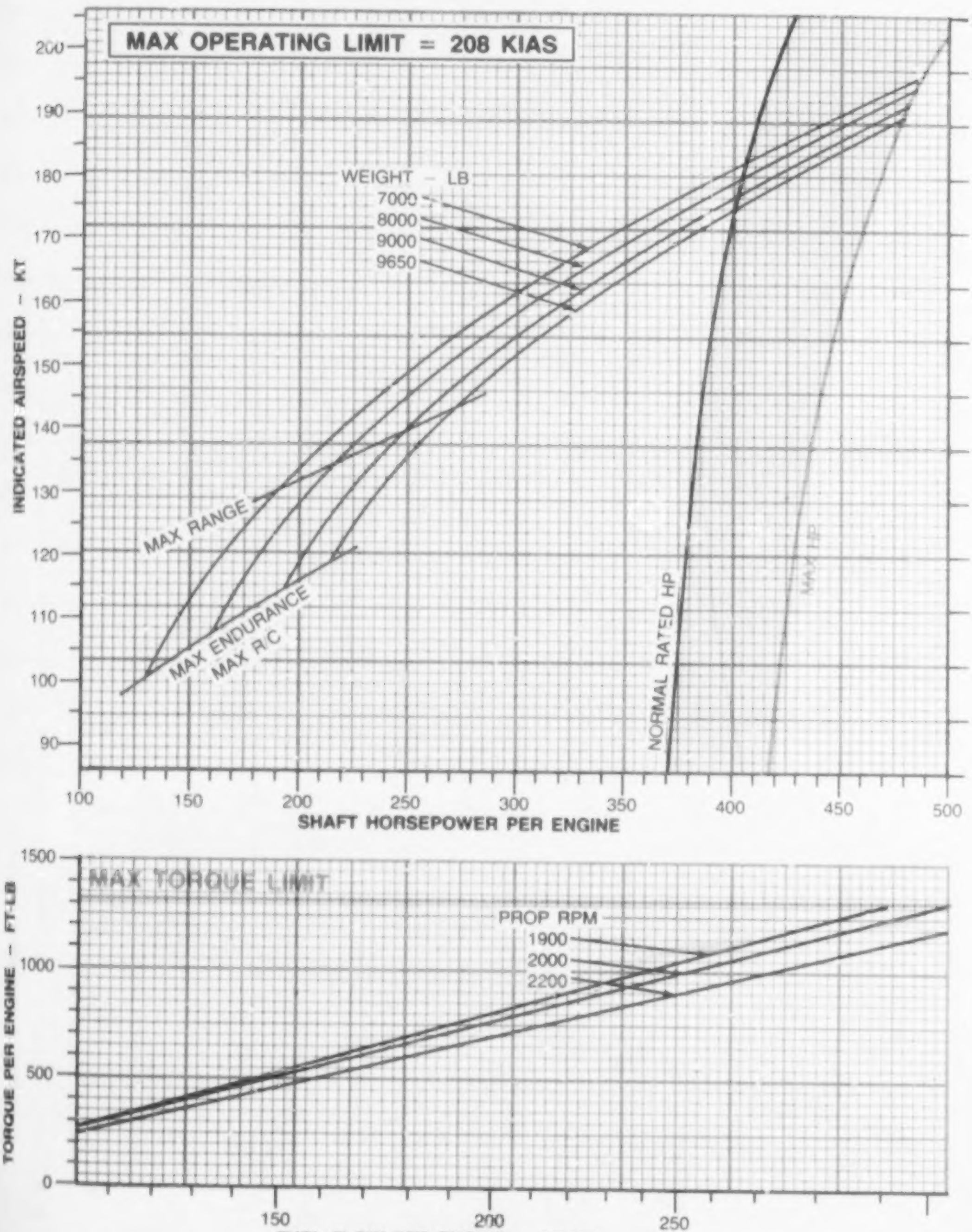
DATA BASIS: ESTIMATED

Figure 7-45. Cruise FAT 20°C, 12,000 Ft

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 16,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −40°C



DATA BASIS: ESTIMATED

AP 004049

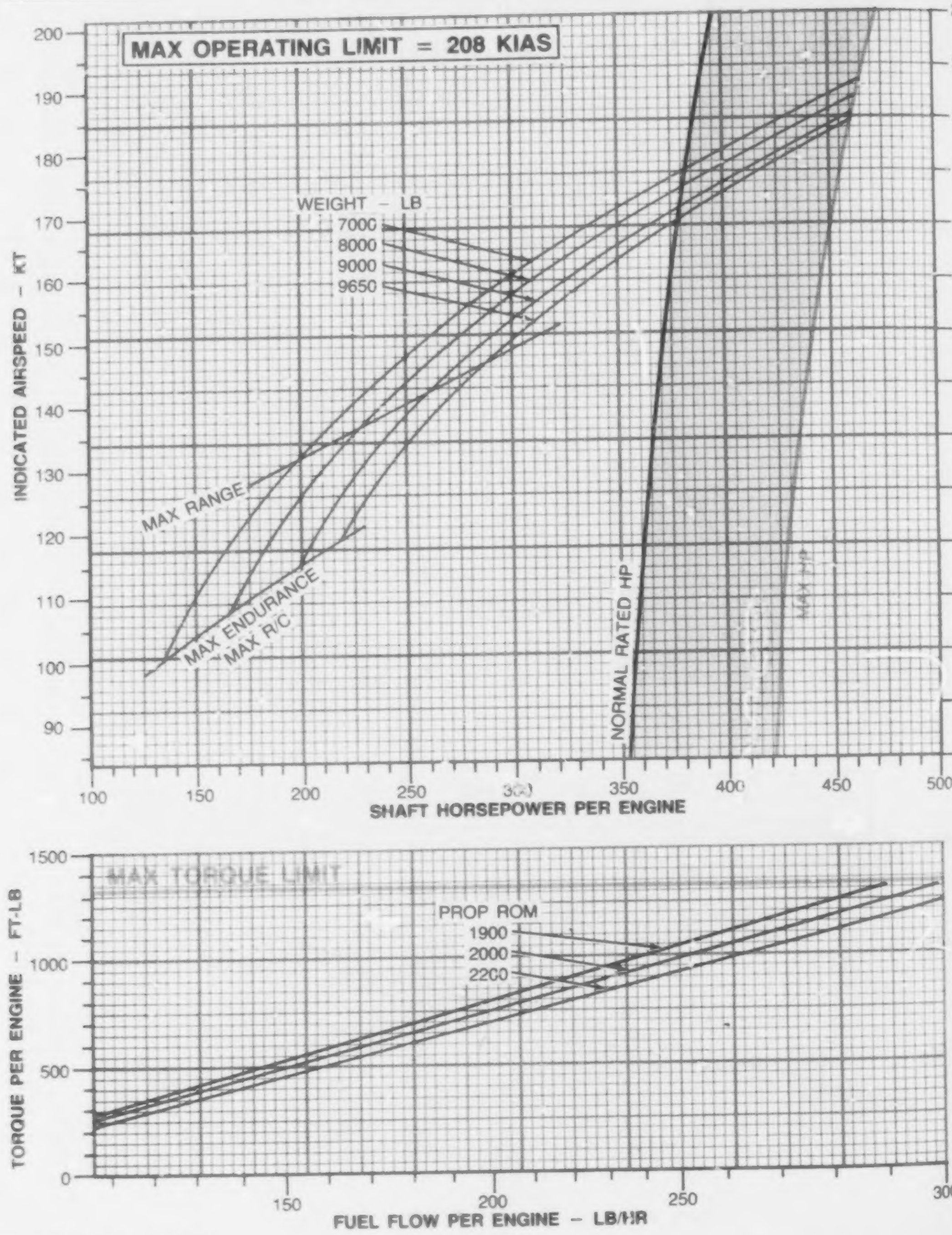
Figure 7-46. Cruise FAT -40°C, 16,000 Ft

CRUISE

CRUISE
U-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 16,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −30°C



DATA BASIS: ESTIMATED

AP 004050

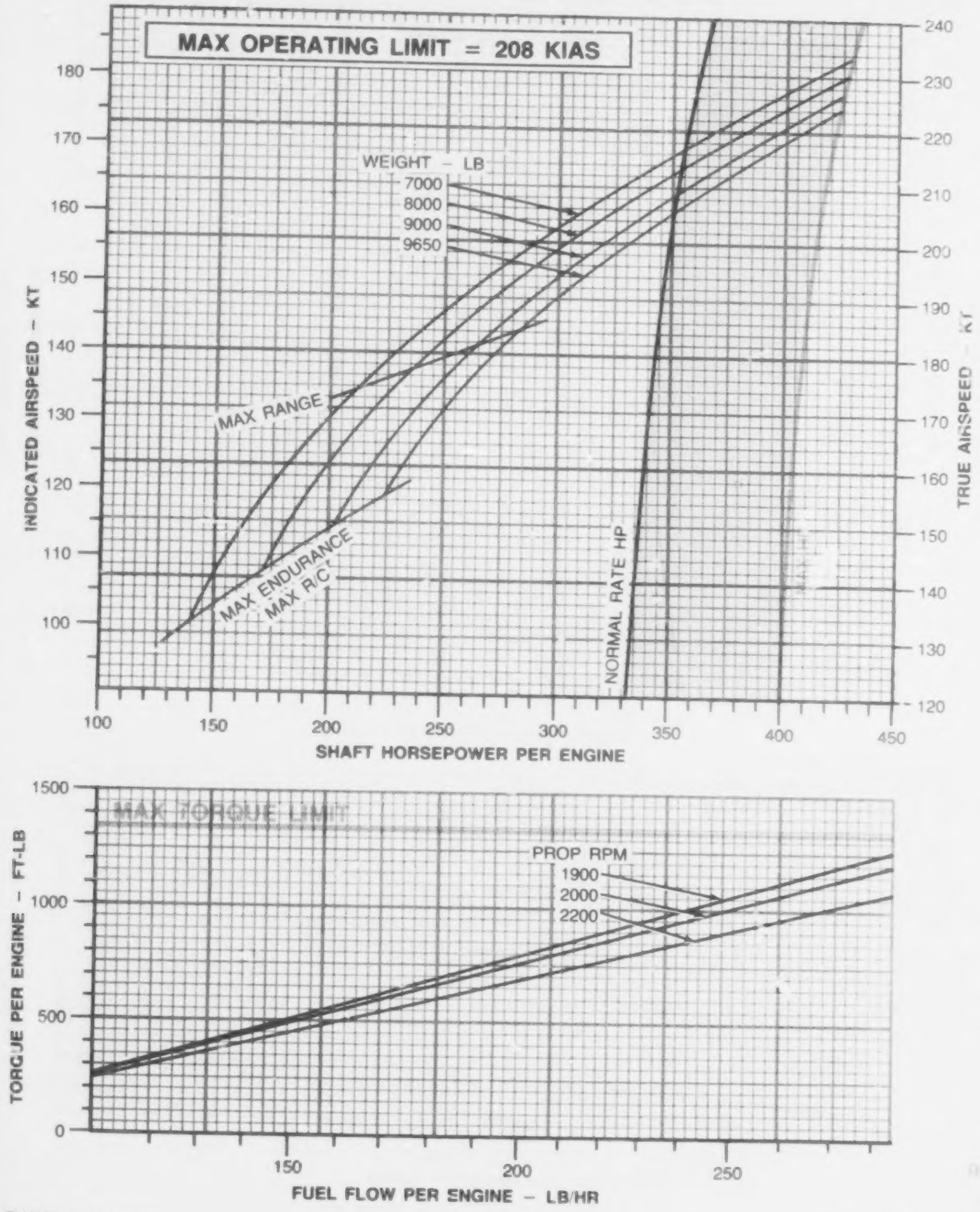
Figure 7-47. Cruise FAT -30°C, 16,000 Ft

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 16,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −20°C

CRUISE
U-21A
T74-CP-700



DATA BASIS: ESTIMATED

AP 004051

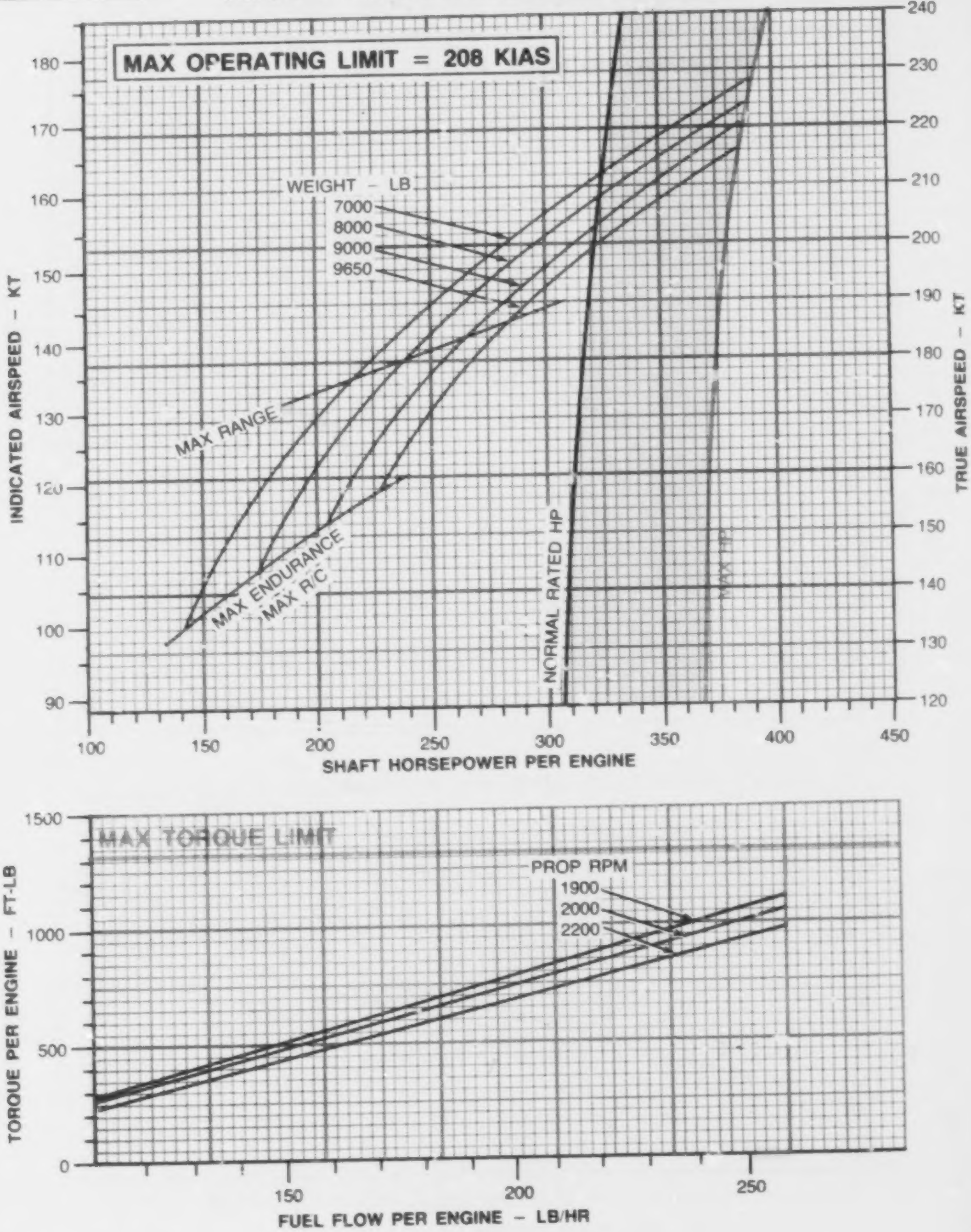
Figure 7-48. Cruise FAT -20°C, 16,000 Ft

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 16,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −10°C

CRUISE
U-21A
T74-CP-700



AP 004052

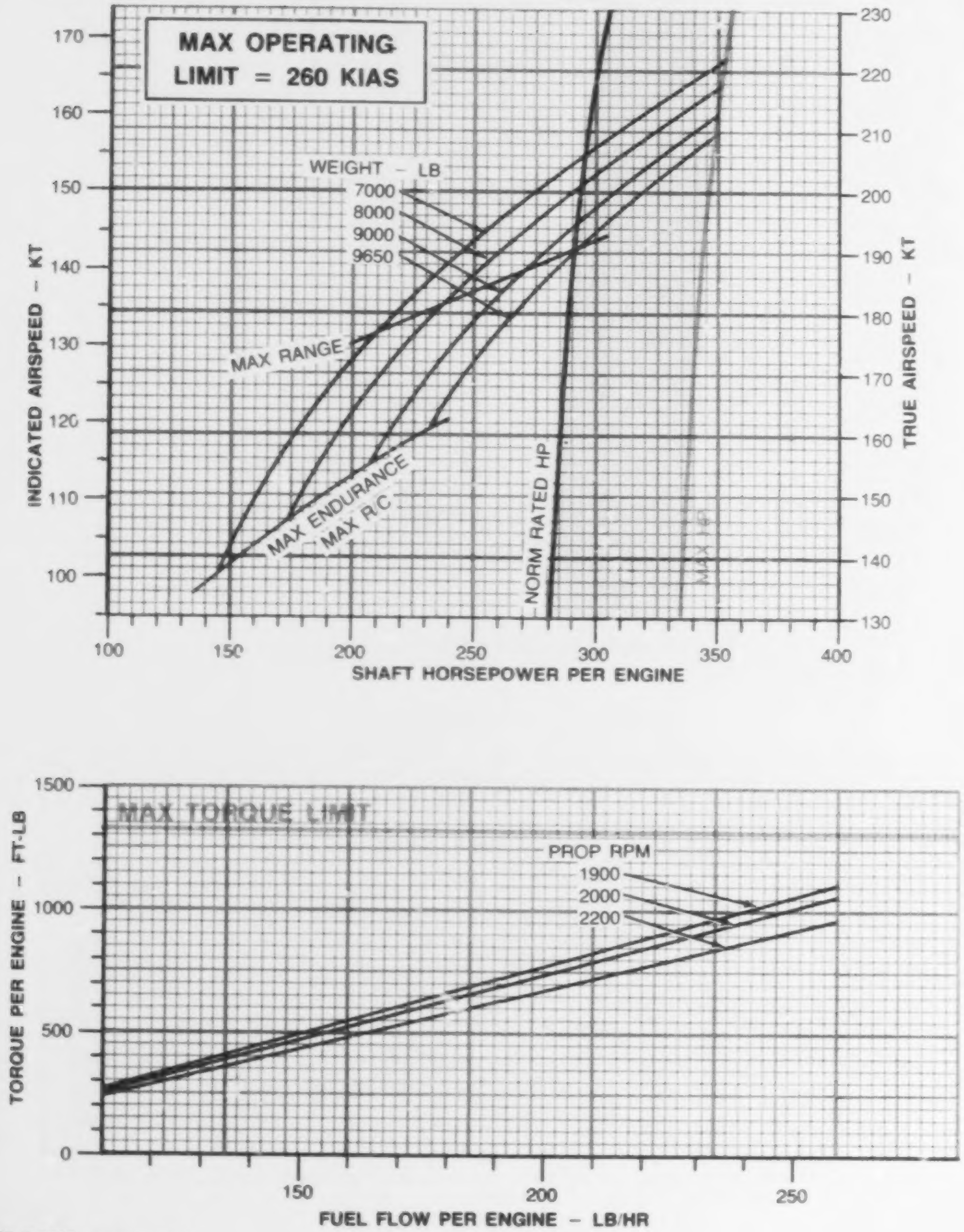
DATA BASIS: ESTIMATED

Figure 7-49. Cruise FAT -10°C, 16,000 Ft

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 16,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 0°C



DATA BASIS: ESTIMATED

AP 004053

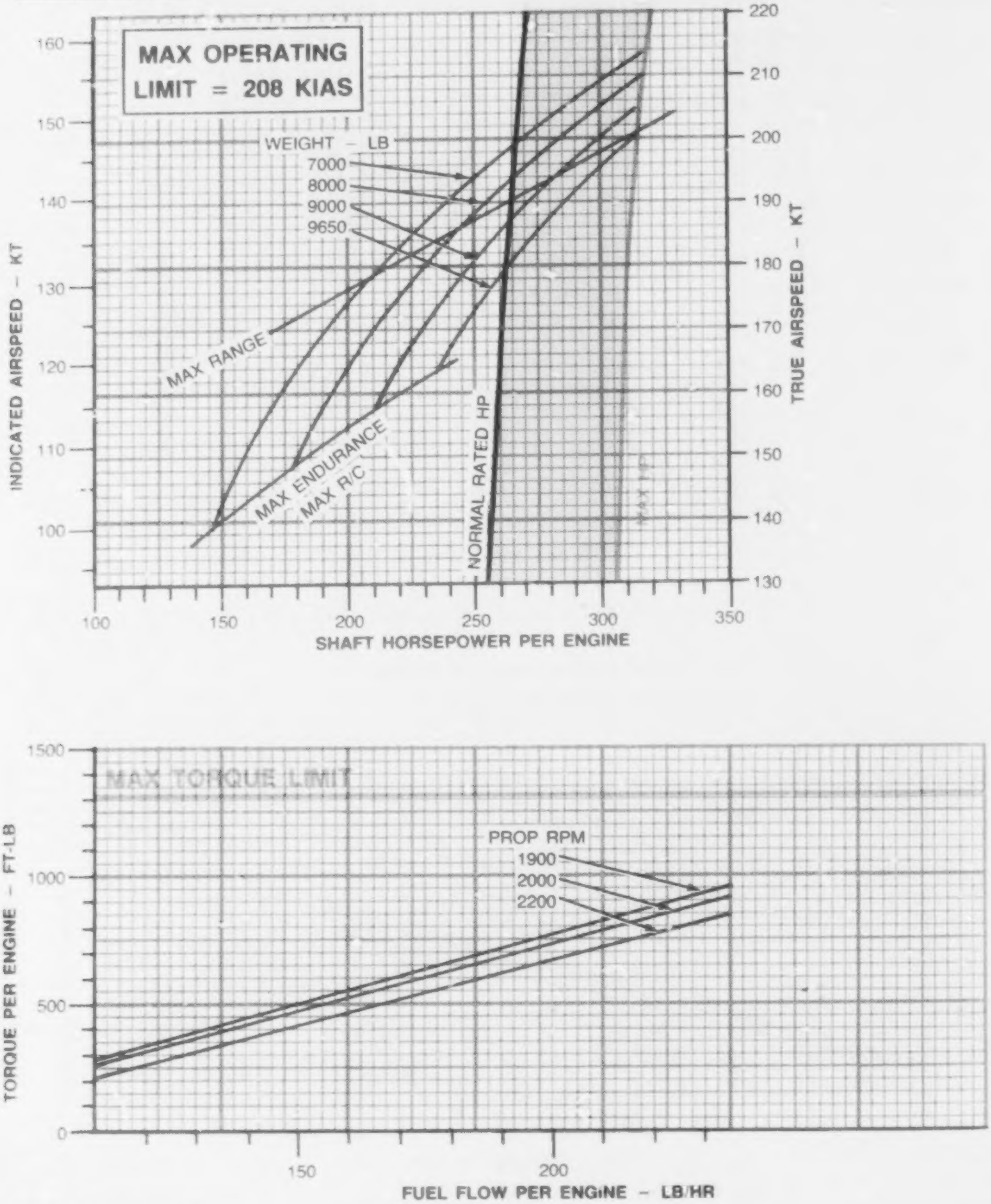
Figure 7-50. Cruise FAT 0°C, 16,000 Ft

CRUISE
U-21A
T74-CP-700

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 16,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 10°C



DATA BASIS: ESTIMATED

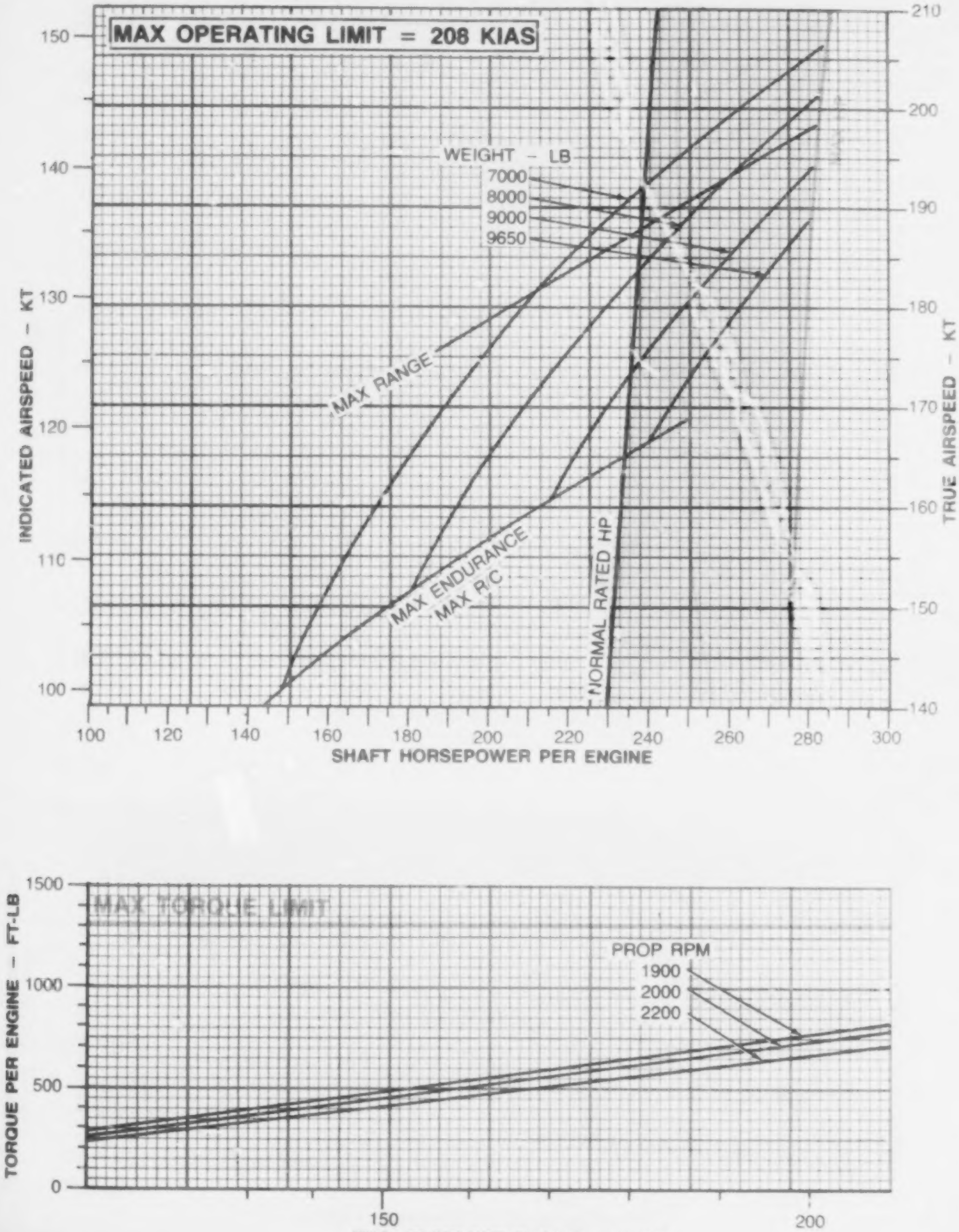
Figure 7-51. Cruise FAT 10°C, 16,000 Ft

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 16,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
U-21A
T74-CP-700

FAT = 20°C



DATA BASIS: ESTIMATED

AP 004055

Figure 7-52. Cruise FAT 20°C, 16,000 Ft

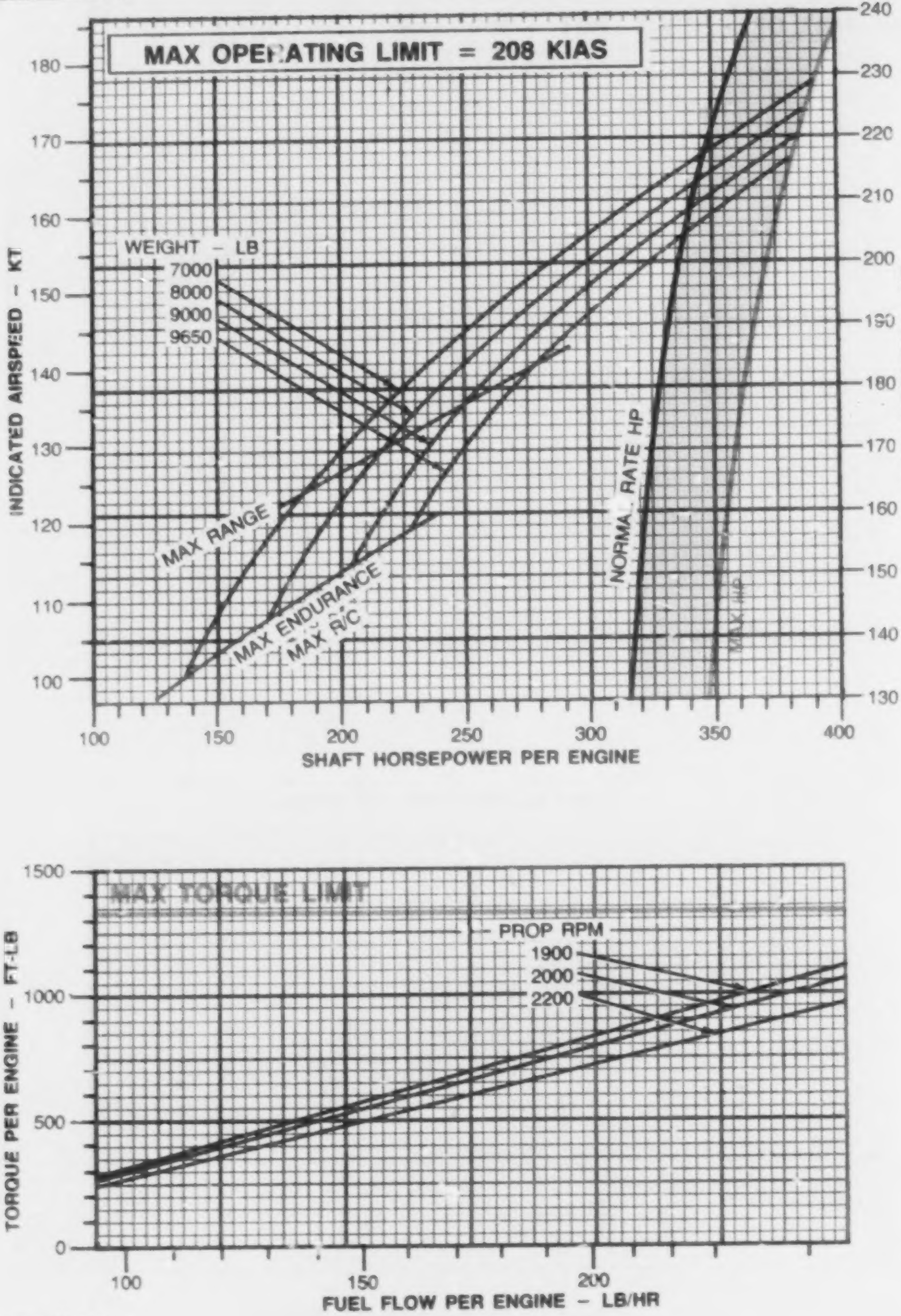
▨
☐

CRUISE

CRUISE
U-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 20,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −50°C



DATA BASIS: ESTIMATED

AP 00-1056

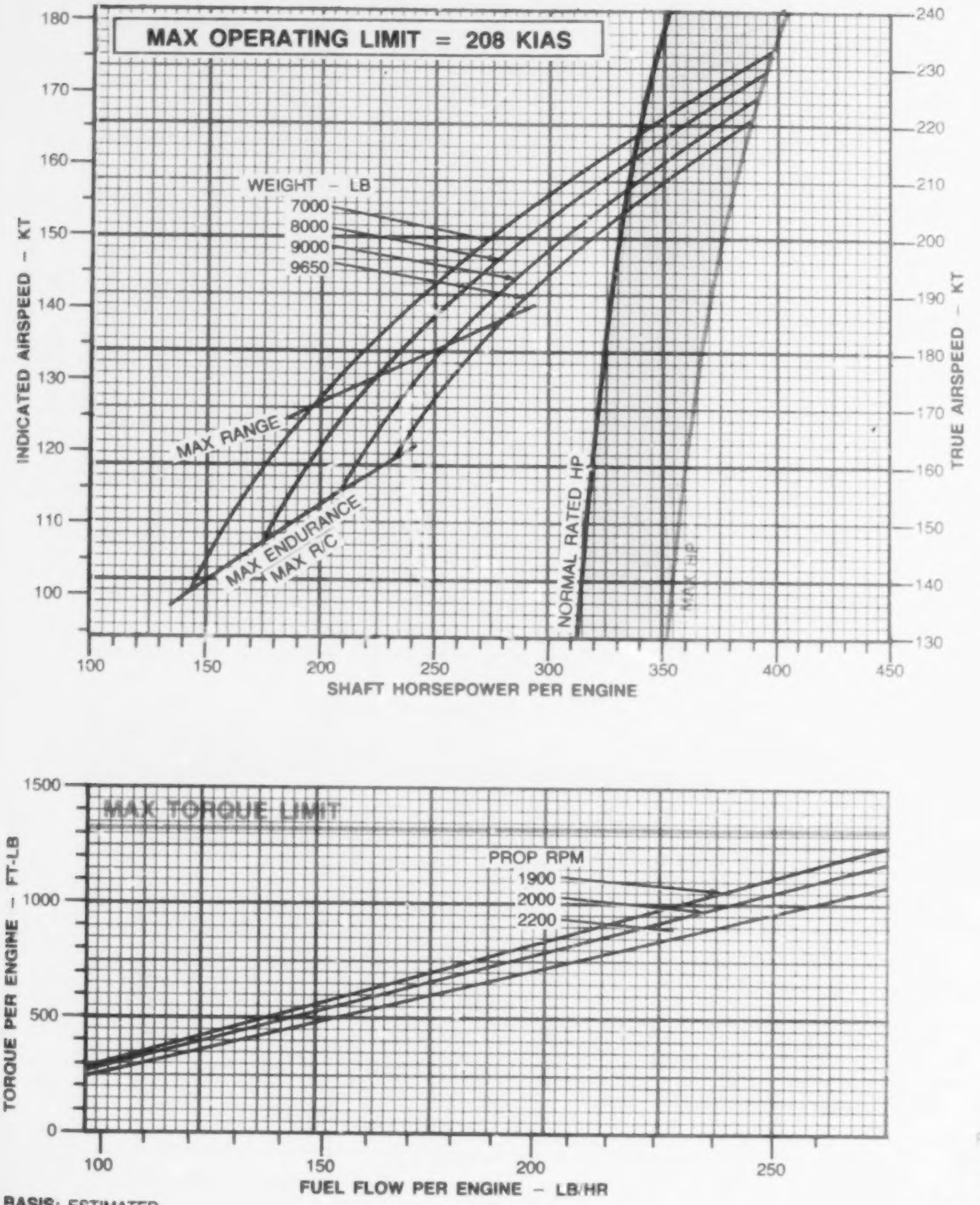
Figure 7-53. Cruise FAT -50°C, 20,000 Ft

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 20,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
U-21A
T74-CP-700

FAT = −40°C



DATA BASIS: ESTIMATED

AP 004057

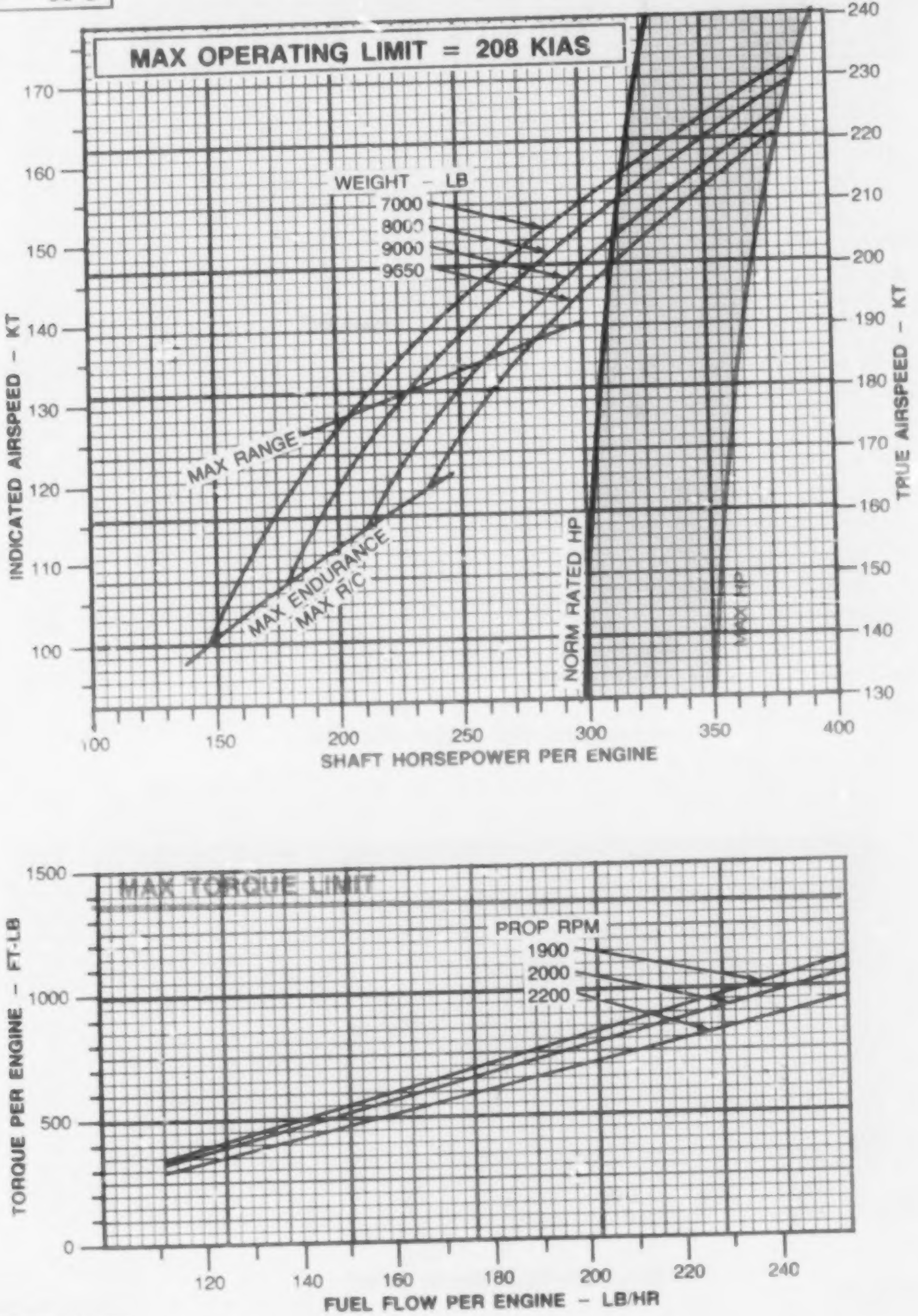
Figure 7-54. Cruise FAT -40°C, 20,000 Ft

CRUISE

CRUISE
U-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 20,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −30°C



DATA BASIS: ESTIMATED

AP 004058

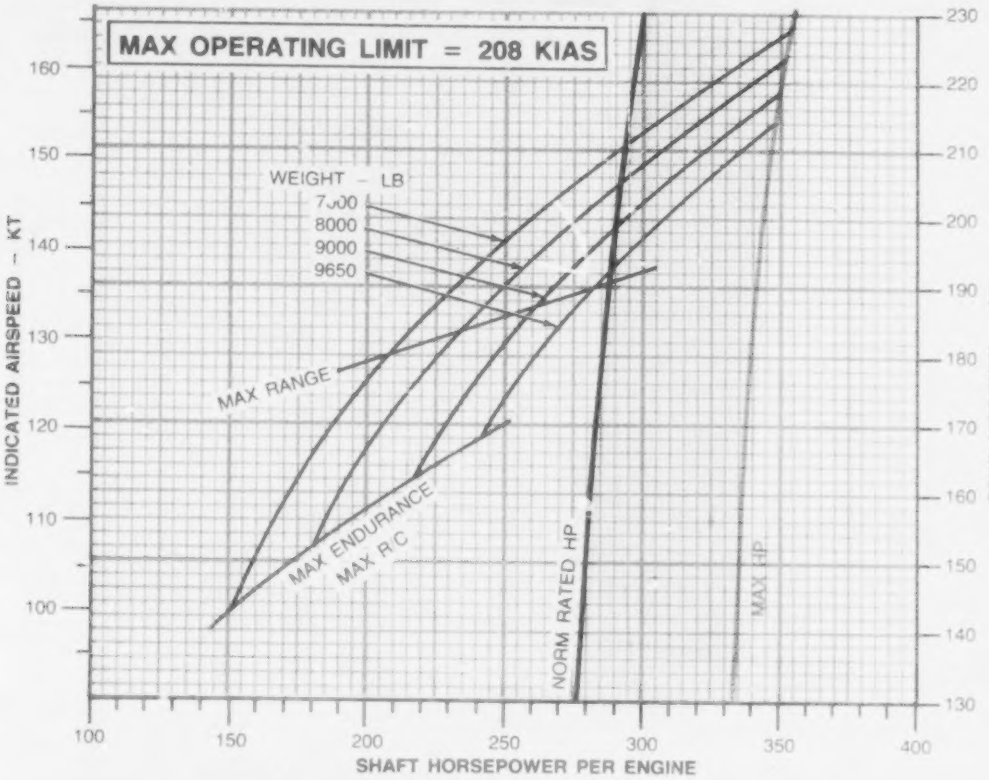
Figure 7-55. Cruise FAT -30°C, 20,000 Ft

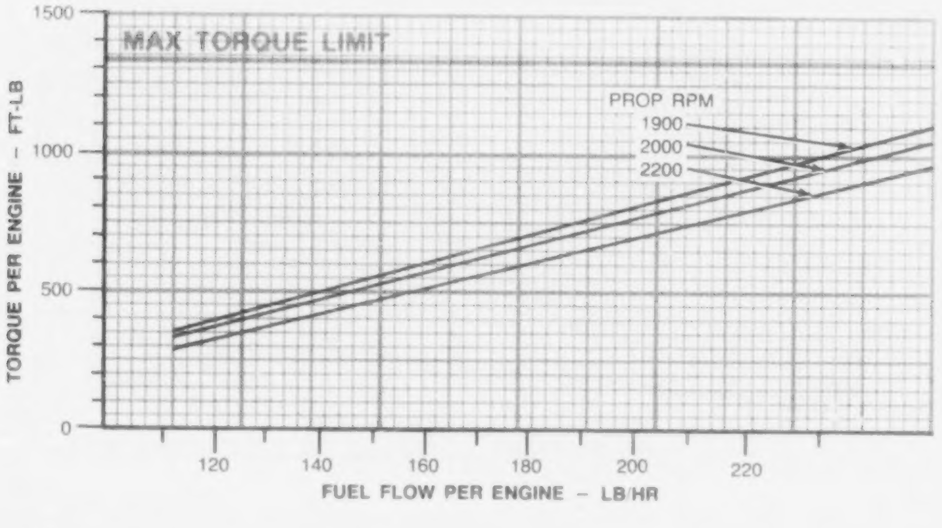
CRUISE

CRUISE
U-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 20,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = -20°C





DATA BASIS: ESTIMATED

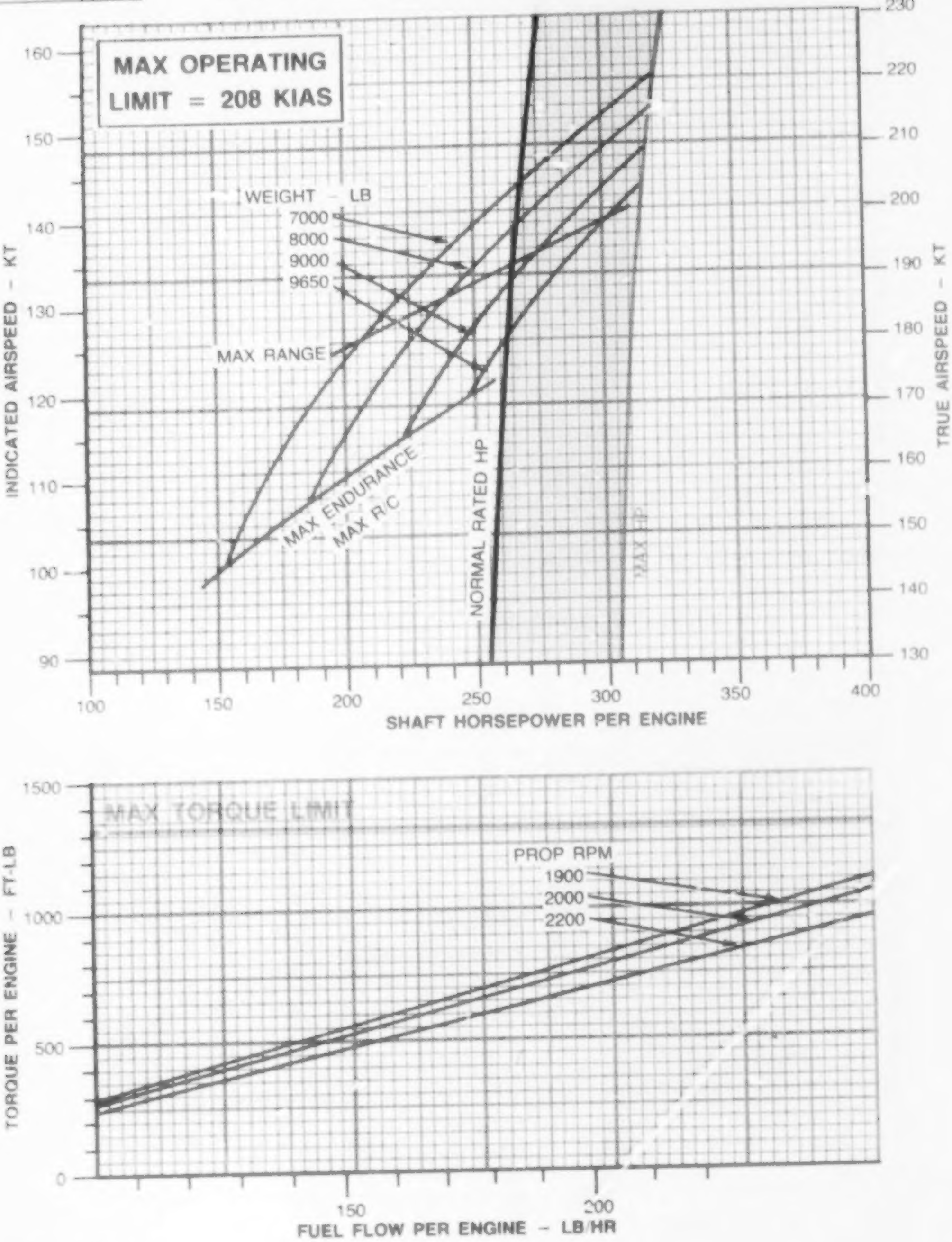
AP 004059

Figure 7-56. Cruise FAT -20°C, 20,000 Ft

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 20,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −10°C



DATA BASIS: ESTIMATED

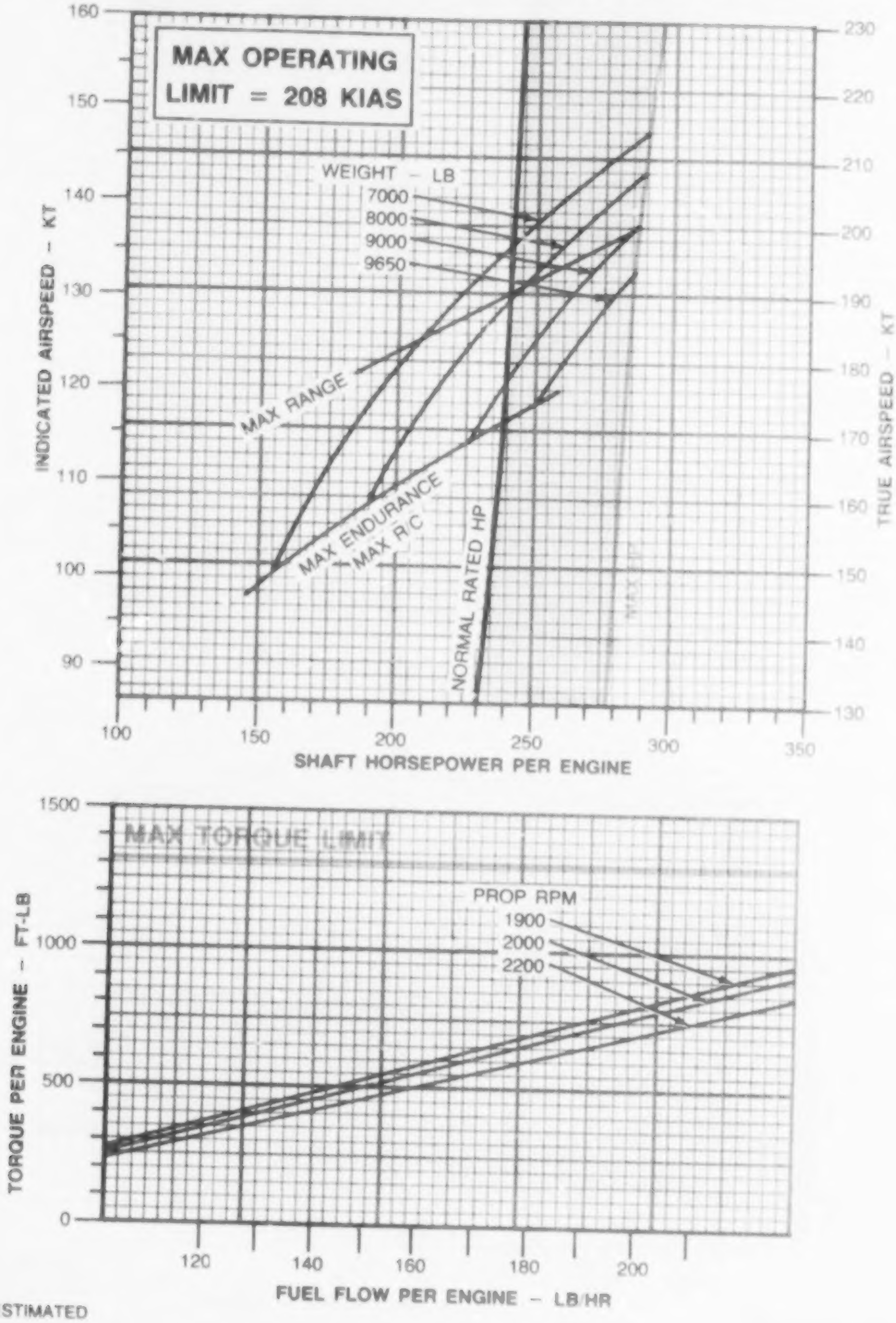
AP 004060

Figure 7-57. Cruise FAT -10°C, 20,000 Ft

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 20,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 0°C



DATA BASIS: ESTIMATED

AP 004061

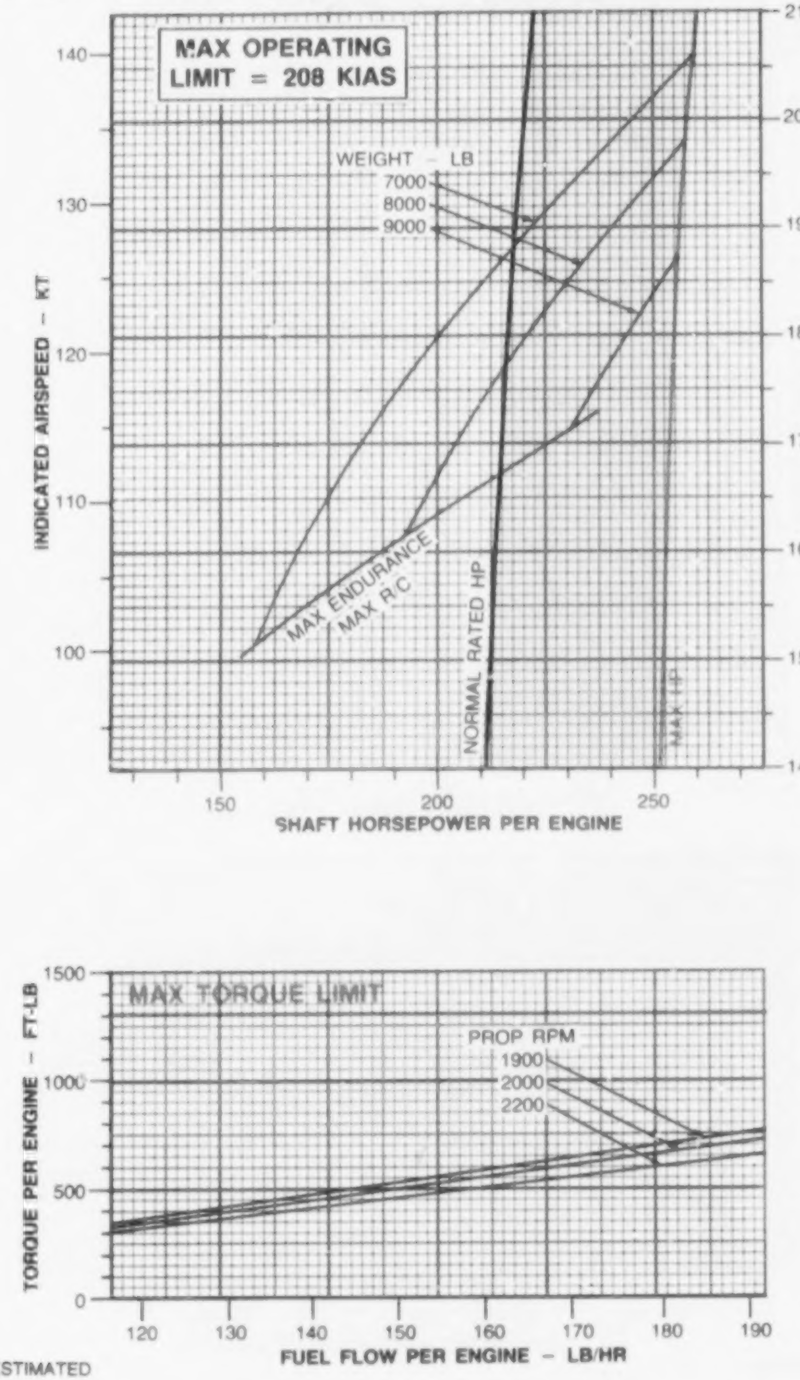
Figure 7-58. Cruise FAT 0°C, 20,000 Ft

CRUISE

**CRUISE
U-21A
T74-CP-700**

TWIN ENGINE
PRESSURE ALTITUDE 20,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 10°C



DATA BASIS: ESTIMATED

AP 004062

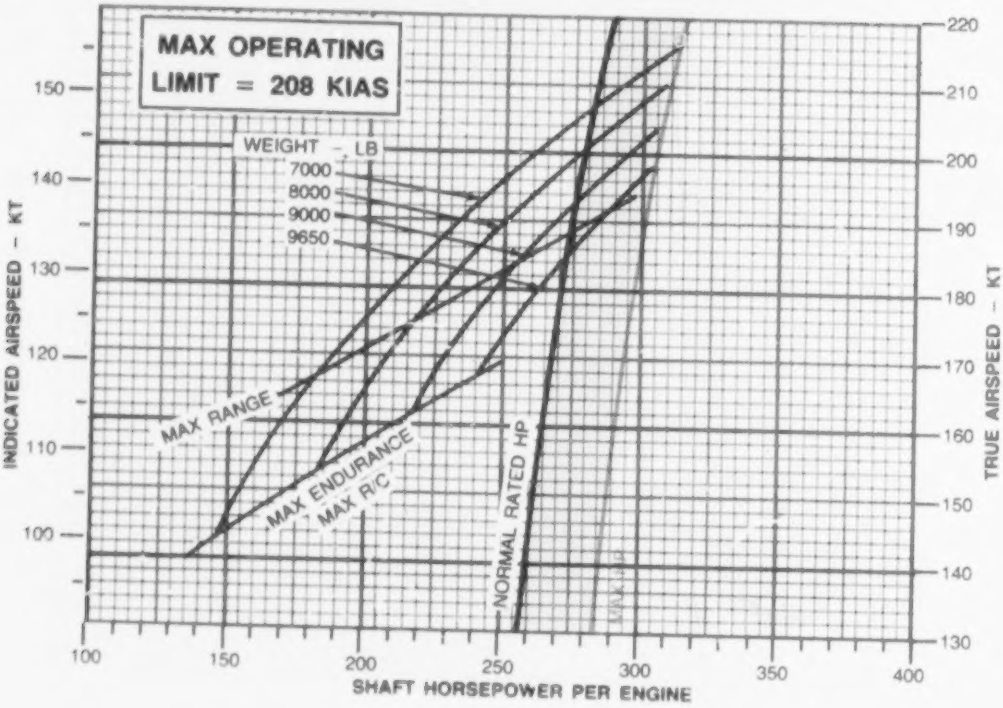
Figure 7-59. Cruise FAT 10°C, 20,000 Ft

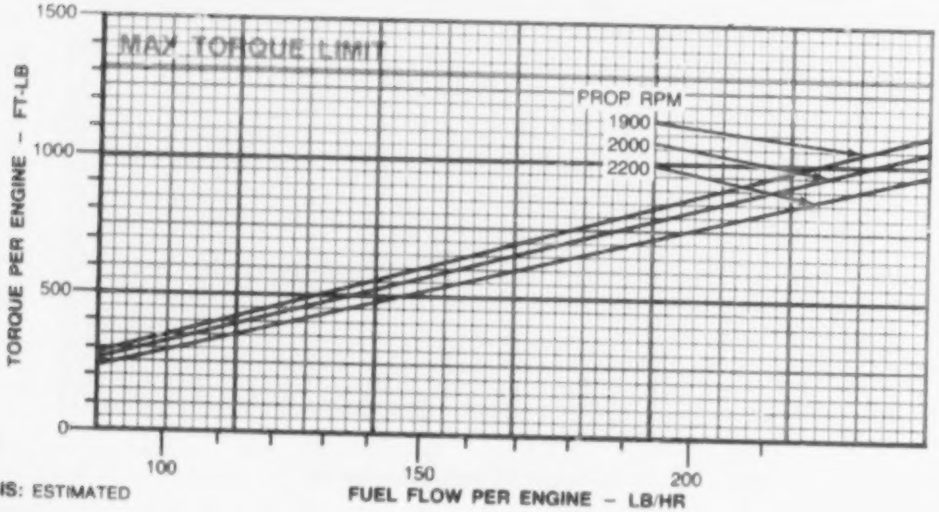
CRUISE

CRUISE
U-21A
T74-CP-700

FAT = −60°C

TWIN ENGINE
PRESSURE ALTITUDE 24,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP





DATA BASIS: ESTIMATED

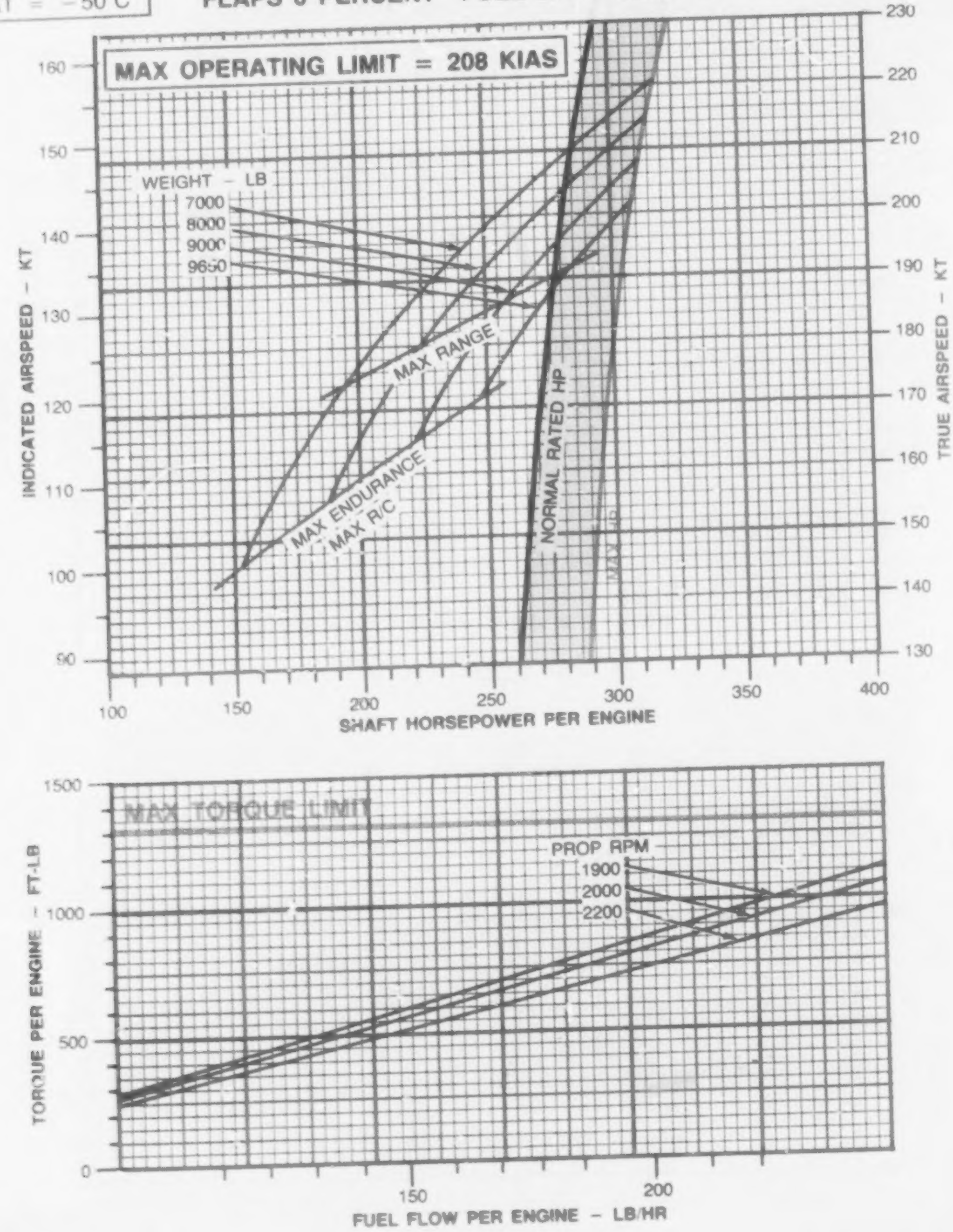
AP 004083

Figure 7-60. Cruise FAT -60°C, 24,000 Ft

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 24,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −50°C



R

AP 004084

DATA BASIS: ESTIMATED

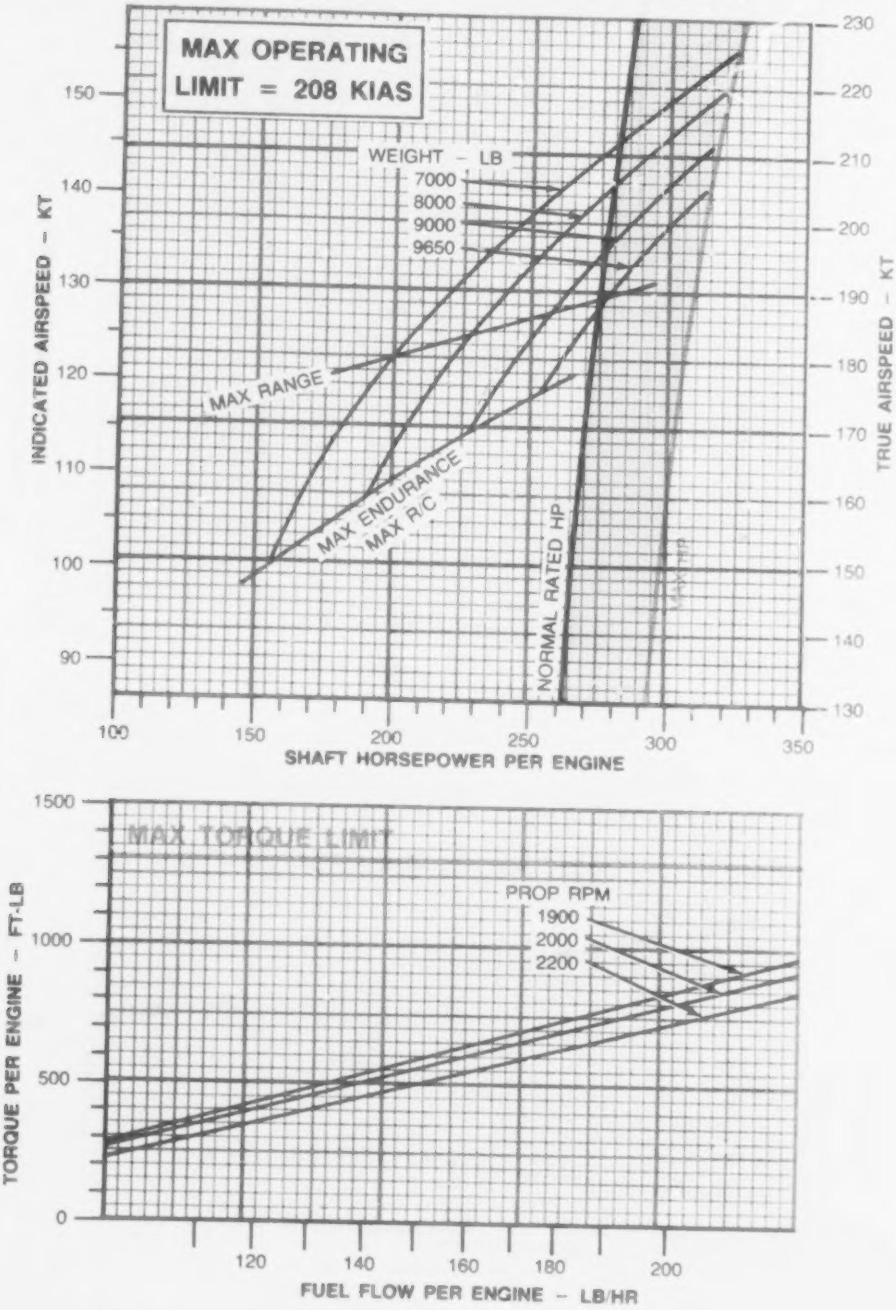
Figure 7-61. Cruise FAT -50°C, 24,000 Ft

CRUISE

CRUISE
U-21A
T74-CP-700

FAT = −40°C

TWIN ENGINE
PRESSURE ALTITUDE 24,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP



DATA BASIS: ESTIMATED

AP 004065

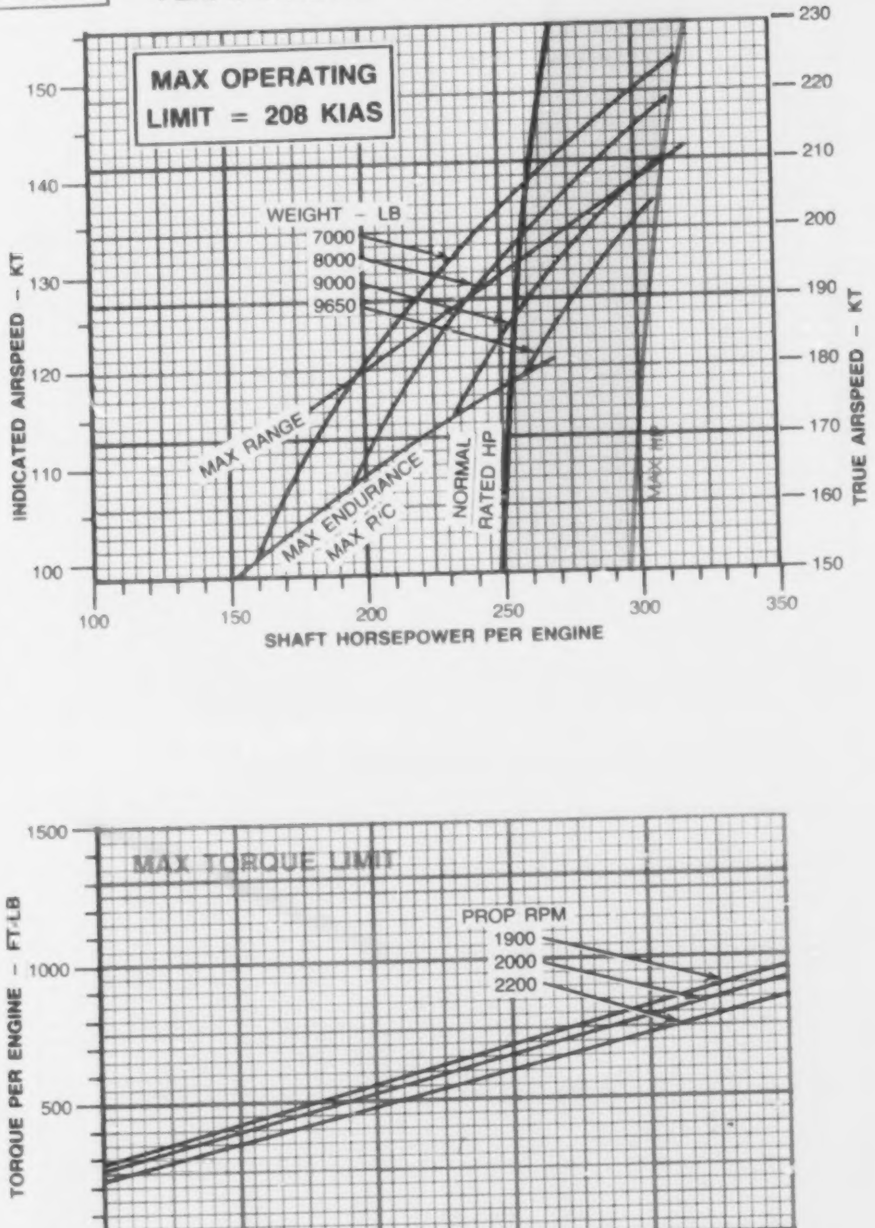
Figure 7-62. Cruise FAT -40°C, 24,000 Ft

CRUISE

CRUISE
U-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 24,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −30°C



AP 004086

DATA BASIS: ESTIMATED

Figure 7-63. Cruise FAT -30°C, 24,000 Ft

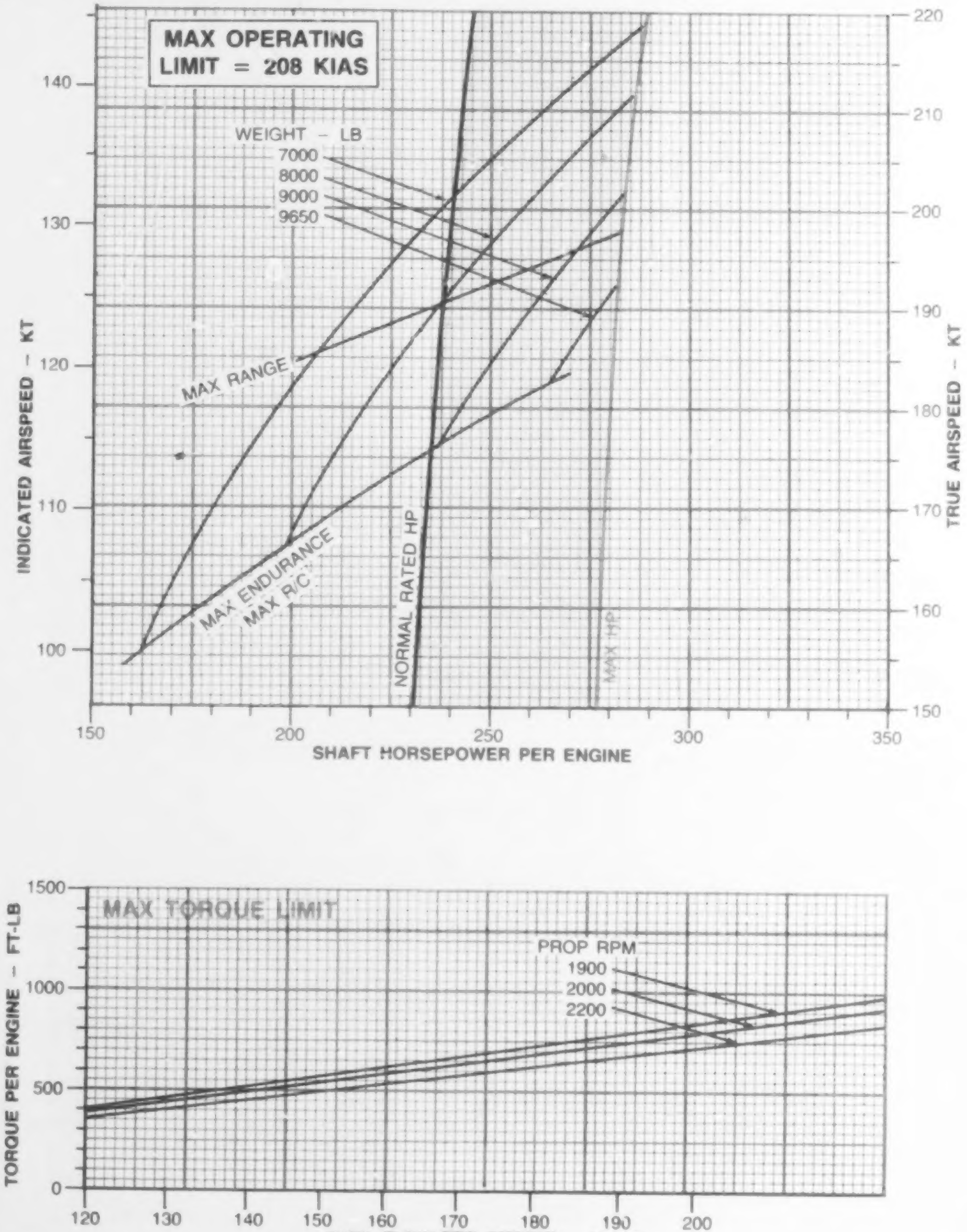
CRUISE
U-21A
T74-CP-700

■
☐

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 24,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = -20°C



DATA BASIS: ESTIMATED

R ■
☐

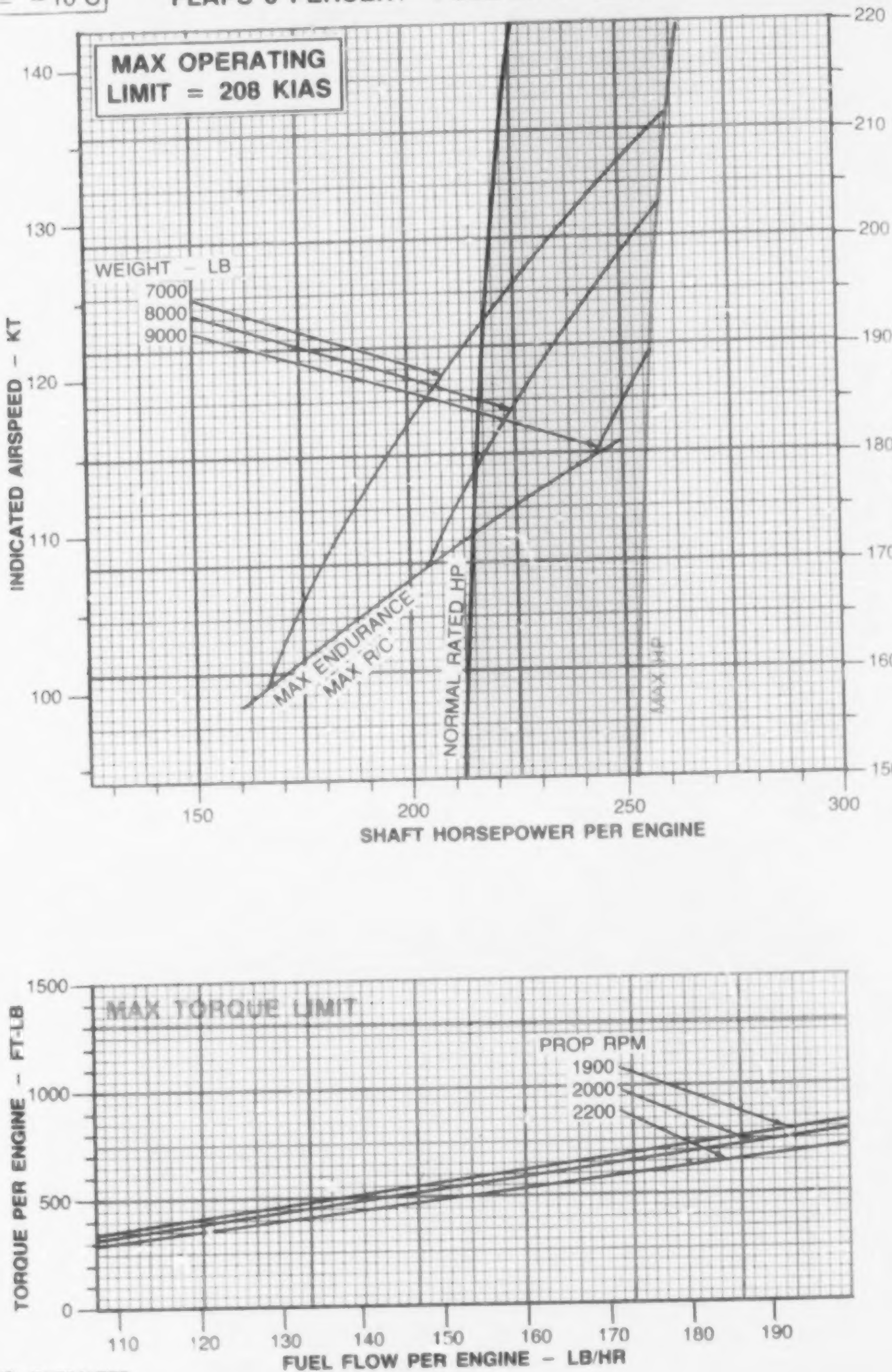
AP 004067

Figure 7-64. Cruise FAT -20°C, 24,000 Ft

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 24,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −10°C



DATA BASIS: ESTIMATED

R

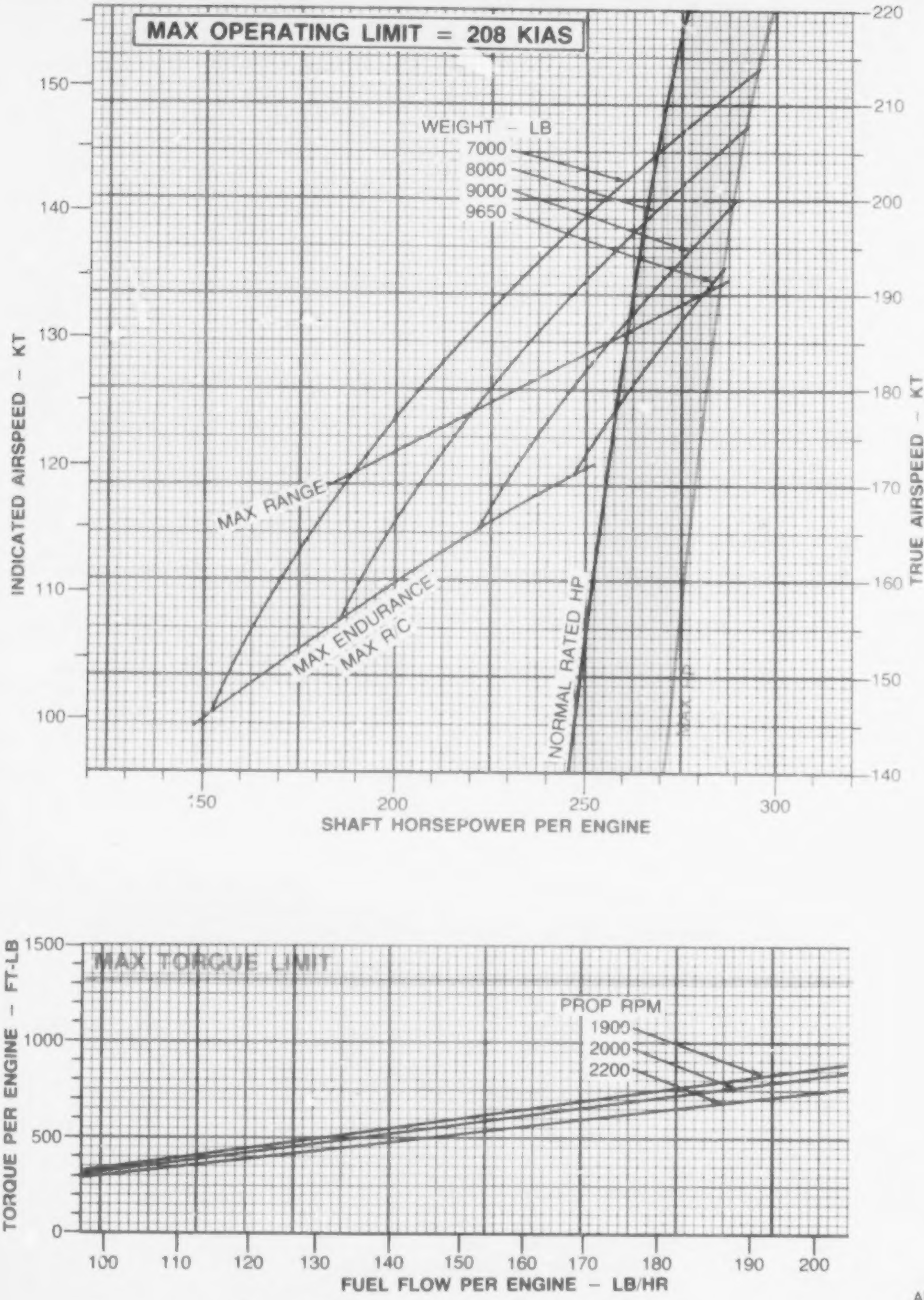
AP 004068

Figure 7-65. Cruise FAT -10°C, 24,000 Ft

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 25,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = -60°C

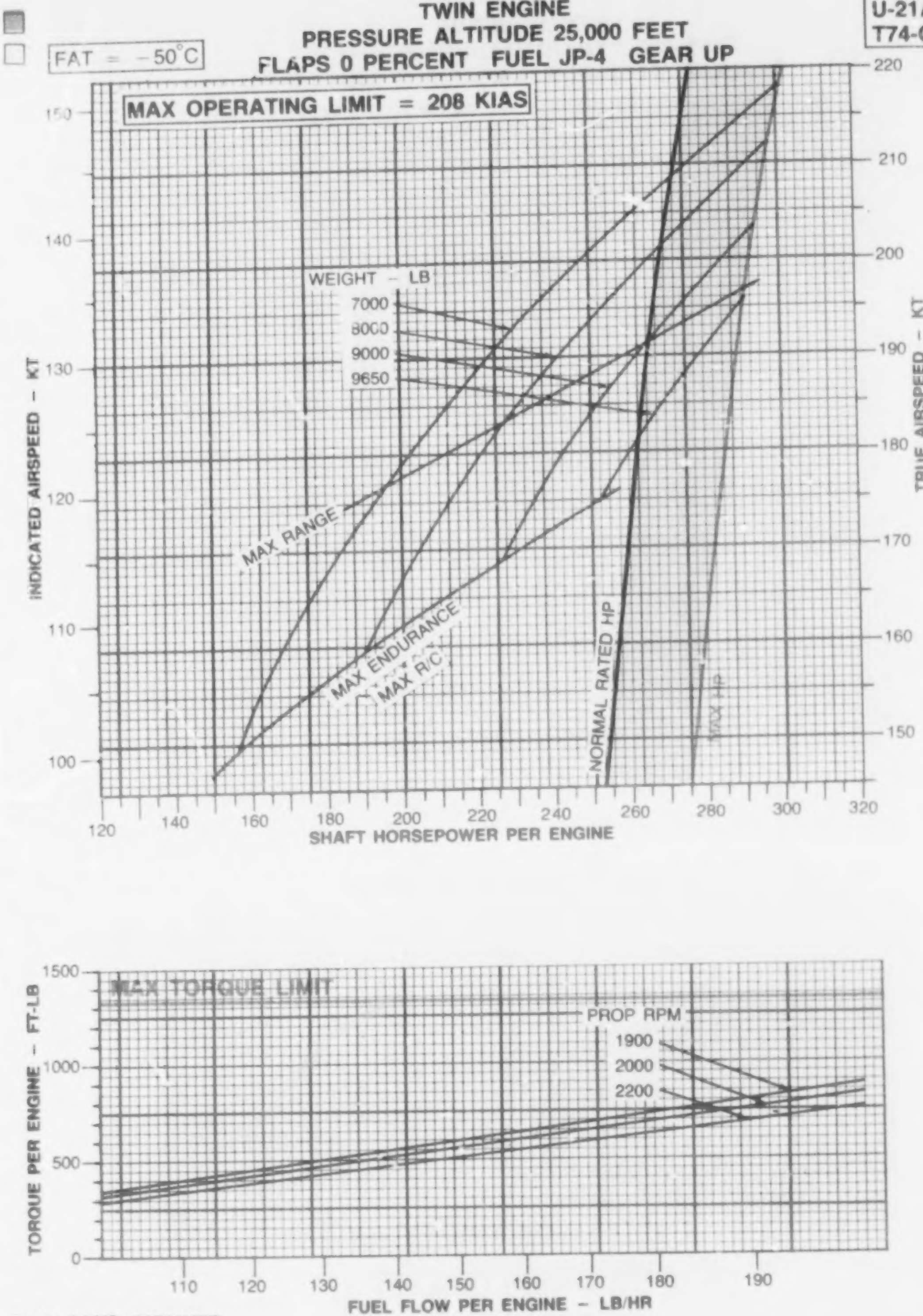


AP 004069

Figure 7-66. Cruise FAT -60°C, 25,000 Ft

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 25,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP



DATA BASIS: ESTIMATED

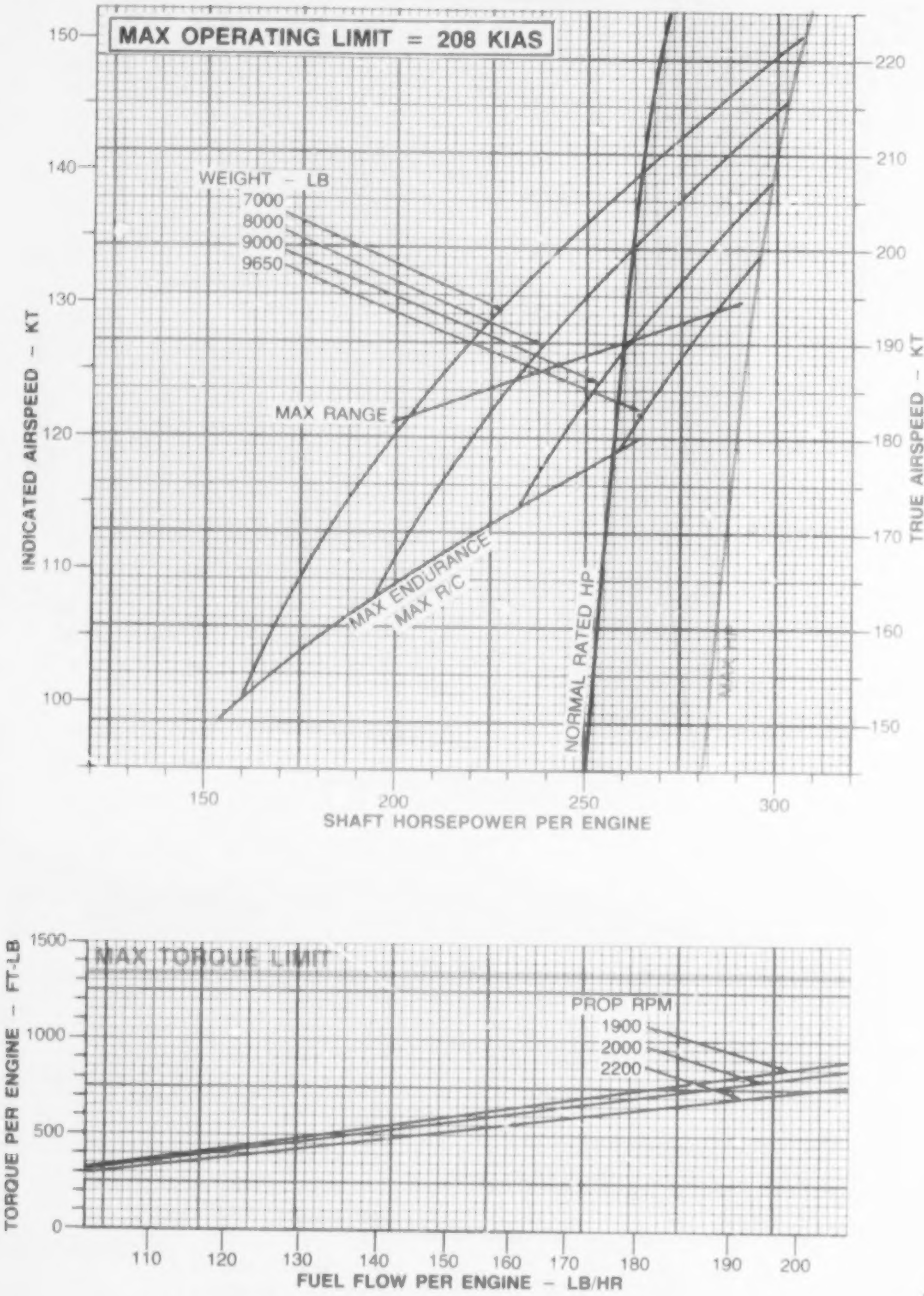
AP 004070

Figure 7-67. Cruise FAT -50°C, 25,000 Ft

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 25,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = -40°C



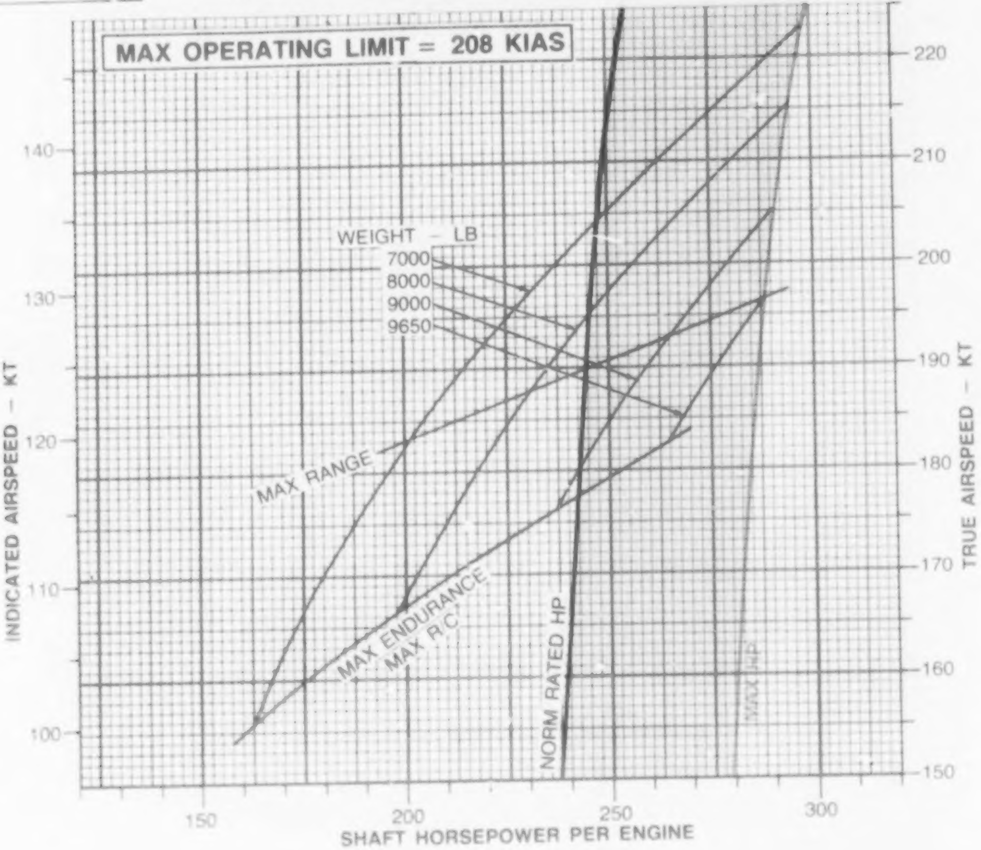
AP 004071

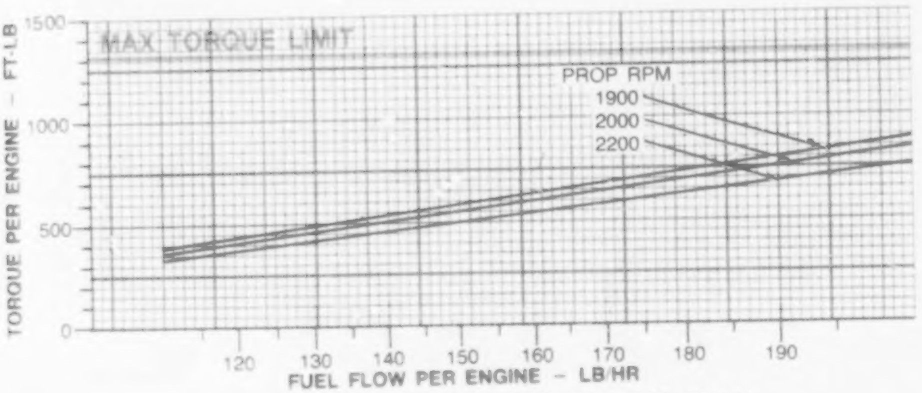
Figure 7-68. Cruise FAT -40°C, 25,000 Ft

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 25,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = -30°C





AP 004072

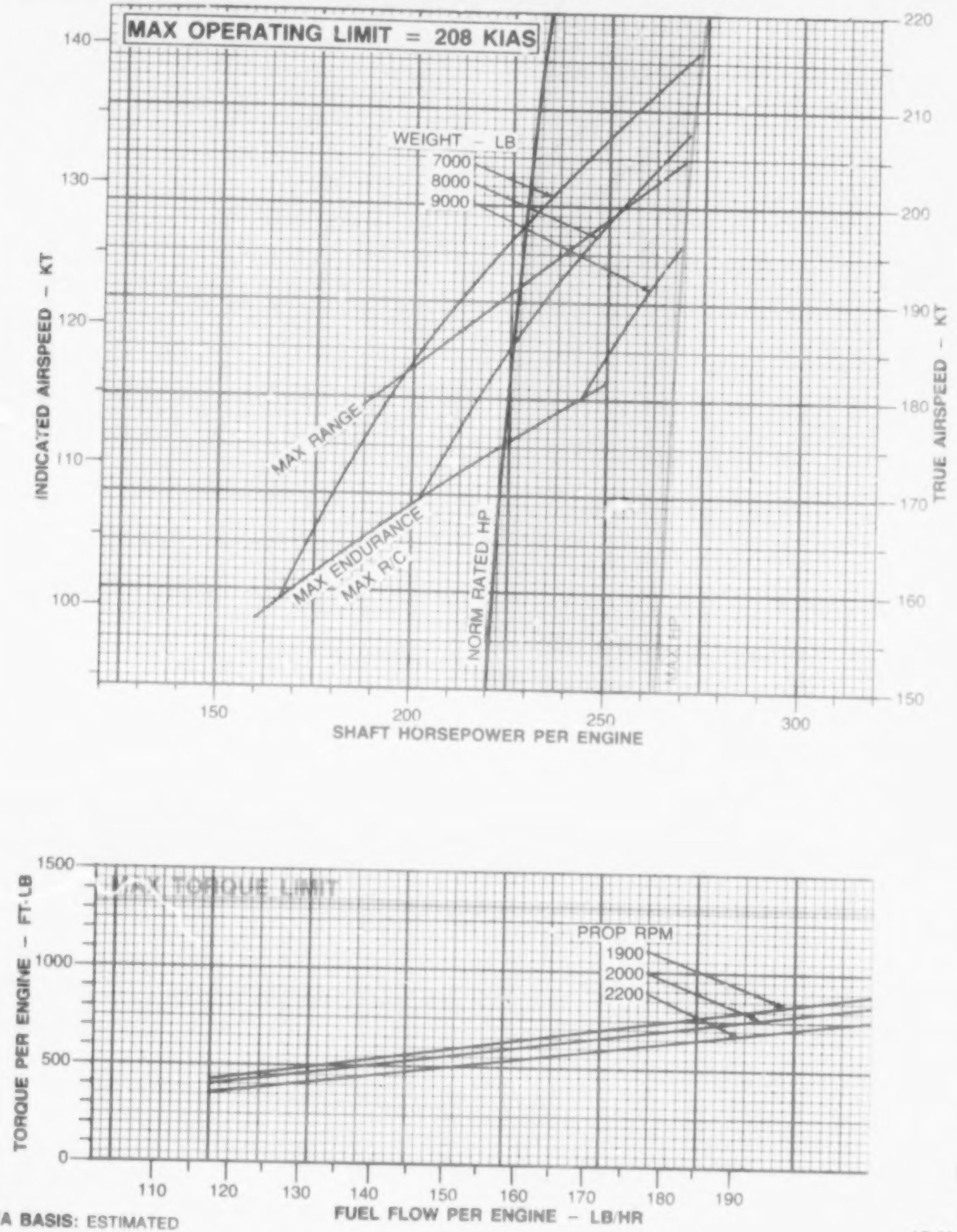
Figure 7-69. Cruise FAT -30°C, 25,000 Ft

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 25,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −20°C

CRUISE
U-21A
T74-CP-700



DATA BASIS: ESTIMATED

AP 004073

Figure 7-70. Cruise FAT -20°C, 25,000 Ft

SECTION XV. CLIMB/DESCENT

7-54. Description.

The Climb/Descent Chart (fig. 7-71), shows the rate-of-climb or descent at a given weight for a change in horsepower per engine and single-engine operation is shown.

7-55 Use of the Chart.

The horsepower per engine required for level flight is obtained from the appropriate Cruise Chart.

a. Climb. The horsepower change per engine is that additional power needed to obtain the desired rate-of-climb at a known weight. The excess horsepower available is obtained from the appropriate Cruise Chart (fig. 7-18 thru 7-70).

b. Descent. The horsepower change per engine is that decrease in power needed to obtain a desired rate-of-descent. Determine torque and propeller speed from the cruise chart.

7-56. Conditions.

a. Power - Maximum climb power.

b. Rate-of-climb/descent will change as altitude and temperature change. Re-evaluate as altitude and temperature change.

CLIMB/DESCENT

GEAR UP FLAPS 0 PERCENT

CLIMB DESCENT
U-21A
T74-CP-700

EXAMPLE XIV-1

WANTED

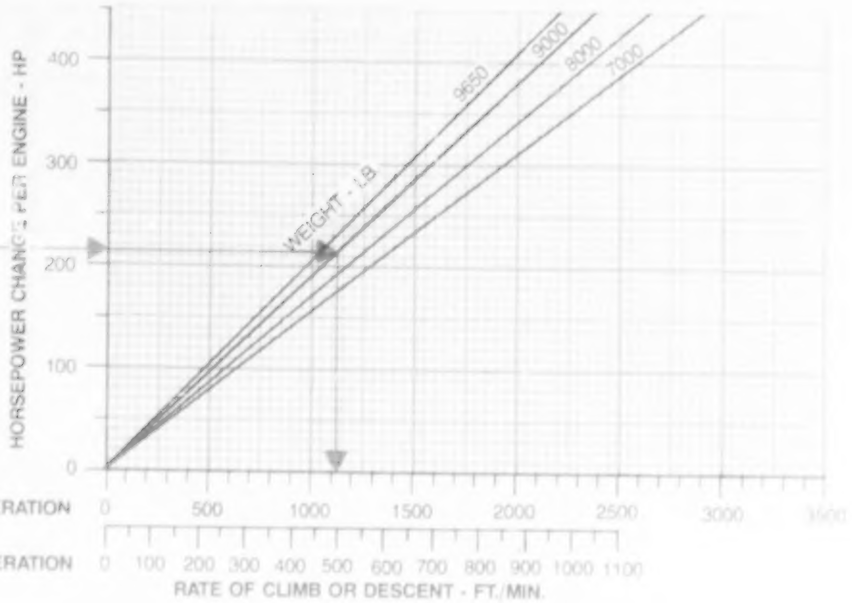
RATE OF CLIMB OR DESCENT AS A RESULT OF CHANGE IN HORSEPOWER

KNOWN

HORSEPOWER CHANGE = 212 HP
WEIGHT = 9000 LB

METHOD

ENTER HORSEPOWER CHANGE HERE
MOVE RIGHT TO WEIGHT = 9000 LB
MOVE DOWN, READ RATE OF CLIMB OR DESCENT = 1120 FT./MIN.



EXAMPLE XIV-1

WANTED

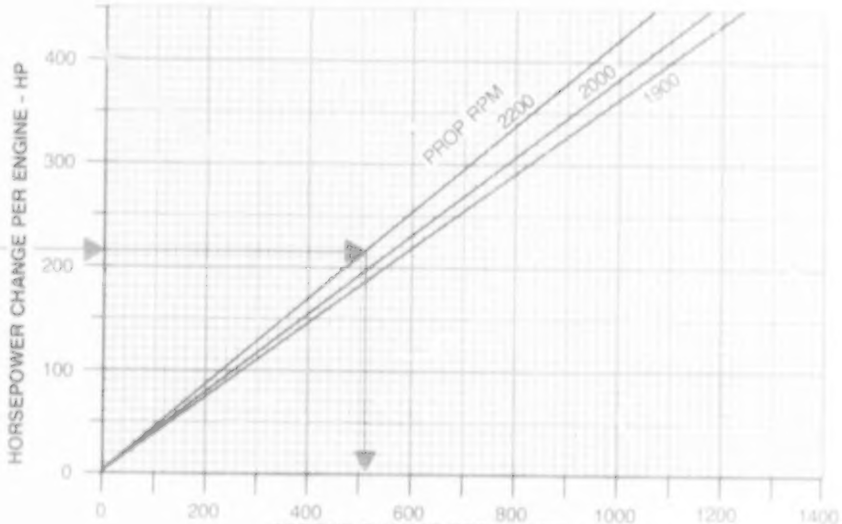
TORQUE CHANGE FOR CLIMB OR DESCENT AS A RESULT OF CHANGE IN HORSEPOWER OR RPM

KNOWN

HORSEPOWER CHANGE = 212 HP
PROP RPM = 2200 RPM

METHOD

ENTER HORSEPOWER CHANGE HERE
MOVE RIGHT TO RPM = 2200 RPM
MOVE DOWN, READ TORQUE CHANGE PER ENGINE = 505 FT. LB.



DATA BASIS: CALCULATED

Figure 7-71. Climb/Descent

SECTION XVI. APPROACH SPEED

7-57. Description.

The Approach Speed Chart (fig. 7-72), shows the variation of approach speed with weight for flaps up and flaps down operation. The landing approach speed (V_{ref}) is the indicated airspeed the aircraft should be at when 50 feet above the runway in landing configuration.

7-58. Use of Chart.

The approach speed line shows the indicated approach airspeed to use for a given aircraft weight.

7-59. Condition.

a. Speeds. These speeds have been selected to provide adequate margins above the stall speeds for the appropriate flap settings.

b. Landing Chart. Performance scheduled on the Landing Chart (fig. 7-73), is based on use of these speeds.

c. Touchdown. The touchdown shall be accomplished at speeds less than those scheduled. Consideration shall be given to the appropriate stall speed from the Stall Speed Chart (fig. 8-4) and to the minimum touchdown speed needed to remain within the recommended area on the Crosswind-Takeoff or Landing Chart (fig. 7-7).

APPROACH SPEED

GEAR DOWN

APPROACH SPEED
U-21A
T74-CP-700

EXAMPLE XV-1

WANTED

RECOMMENDED APPROACH SPEED FOR KNOWN WEIGHT

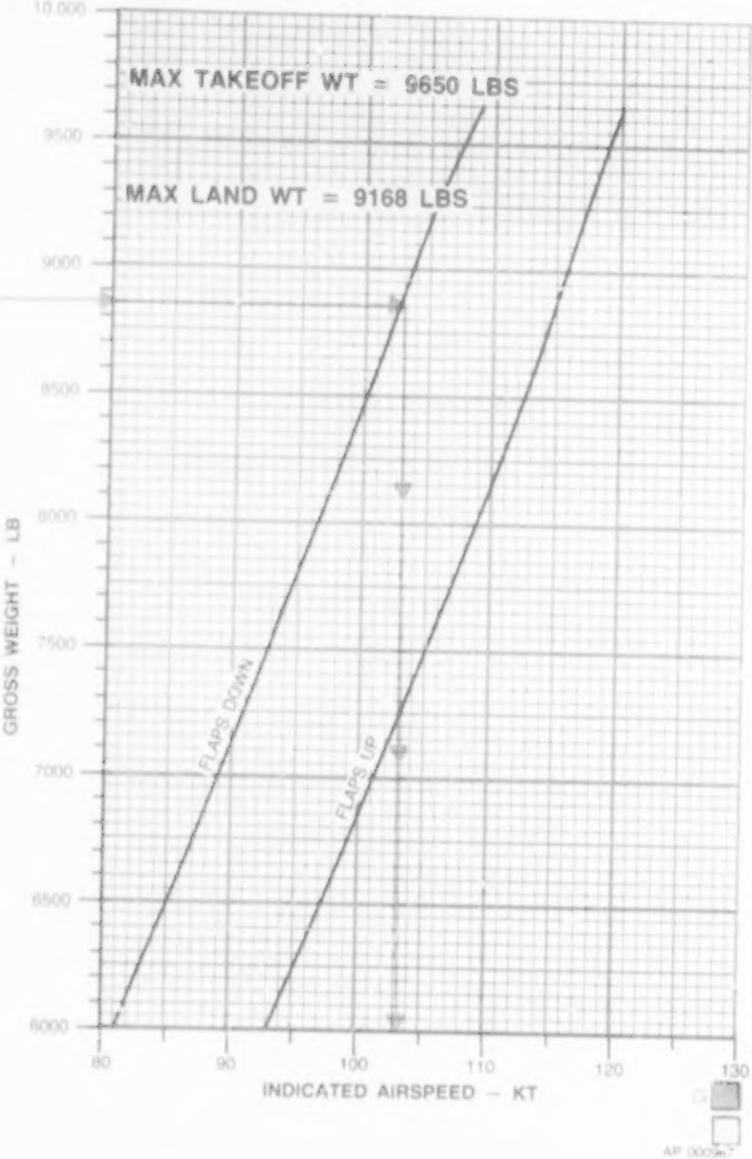
KNOWN

WEIGHT = 8855 LB

FLAP SETTING = DOWN

METHOD

ENTER WEIGHT HERE
MOVE RIGHT TO APPROACH SPEED LINE, FLAPS DOWN
MOVE DOWN, READ INDICATED AIRSPEED = 103 KT



DATA BASIS: FLIGHT TEST

Figure 7-72. Approach Speed

SECTION XVII. LANDING

7-60. Description.

The Landing Chart (fig. 7-73), shows the total ground roll distance required for varying air temperatures, altitudes, weights and flap positions.

NOTE

> Landing data is provided up to weights of 9650 pounds in the event emergency landing is required immediately after takeoff. Any time the maximum landing weight of 9168 pounds is exceeded, an appropriate entry shall be made on DA Form 2408-13.

a. Use of Chart. Power - As required (on final approach).

b. Flaps - As selected.

c. Landing Gear - DN.

d. Technique - Establish 800 TR/MIN descent on final approach at the appropriate airspeed from the Approach Speed Chart (fig. 7-72). When landing is assured, reduce power and speed.

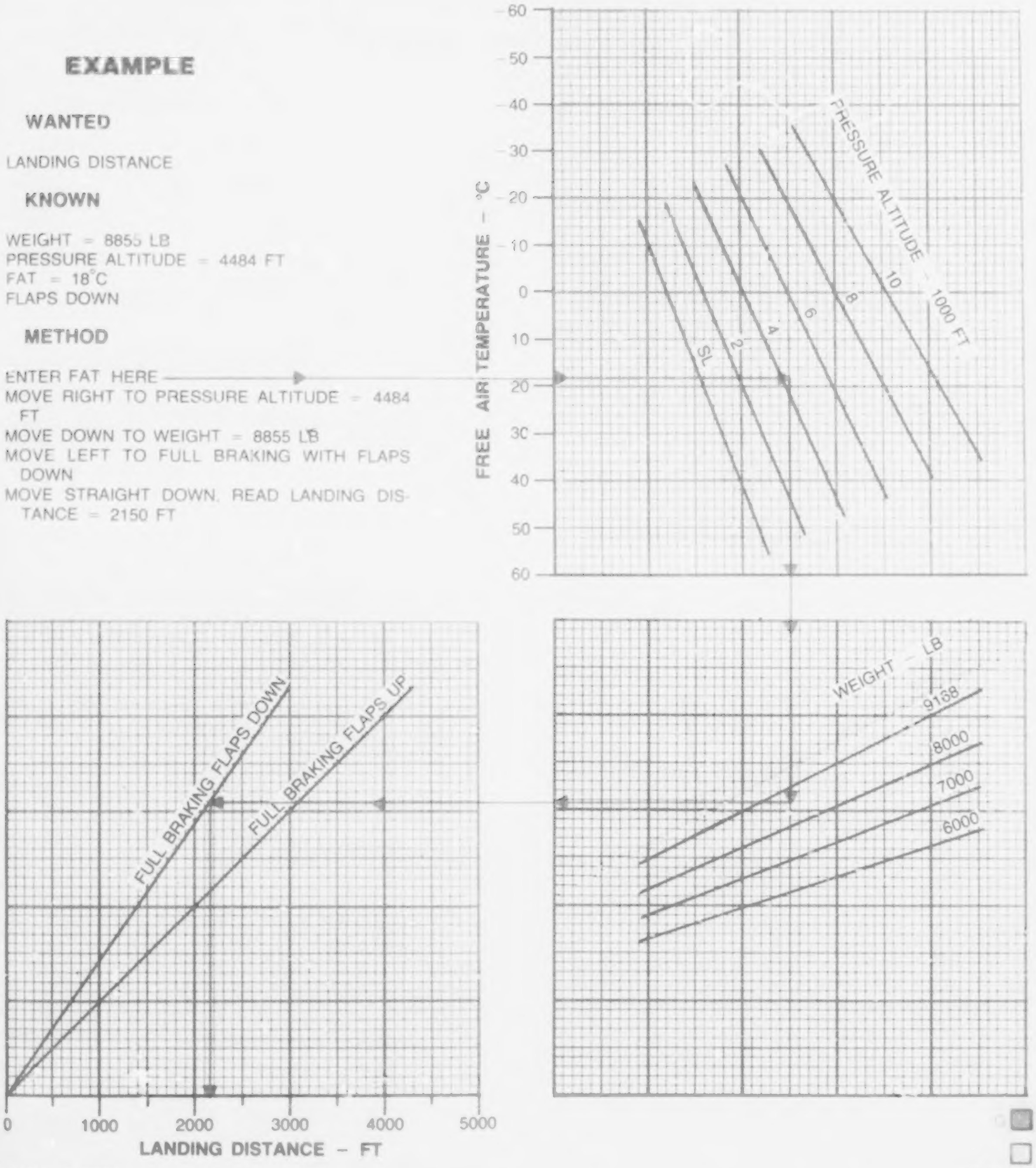
e. Runway - Runway conditions for this chart are based on a dry, level hard-surface. Conditions other than these may vary aircraft landing distance. Distance decreased approximately 4% per 1% uphill gradient. Distance increases approximately 4% per 1% downhill gradient.

f. Wind - All data presented are based on calm wind conditions. Distance decreases approximately 1% per knot headwind. Distance increases approximately 4% per knot tailwind.

LANDING

CALM WINDS LEVEL, DRY, HARD SURFACE
MAX BRAKING AND IDLE POWER ON RUNWAY

LANDING
U-21A
T74-CP-700



EXAMPLE

WANTED

LANDING DISTANCE

KNOWN

WEIGHT = 8855 LB
PRESSURE ALTITUDE = 4484 FT
FAT = 18°C
FLAPS DOWN

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE = 4484 FT
MOVE DOWN TO WEIGHT = 8855 LB
MOVE LEFT TO FULL BRAKING WITH FLAPS DOWN
MOVE STRAIGHT DOWN. READ LANDING DISTANCE = 2150 FT

DATA BASIS: CALCULATED

Figure 7-73. Landing

CHAPTER 8

NORMAL PROCEDURES

SECTION I. MISSION PLANNING

8-1. Mission Planning.

Mission planning begins when the mission is assigned and extends to the preflight of the aircraft. It includes, but is not limited to, checks of operating limits and restrictions; weight, balance, and loading; performance; publications; flight plan; and crew and passenger briefings. The pilot in command shall ensure compliance with the contents of this manual that are applicable to the mission.

8-2. Operating Limits and Restrictions.

The minimum, maximum, normal, and cautionary operational ranges represent careful aerodynamic and structural calculations, substantiated by flight test data. These limitations must be adhered to during all phases of the mission. Refer to Chapter 5, OPERATING LIMITS AND RESTRICTIONS, for detailed information.

8-3. Weight/Balance, and Loading.

The aircraft must be loaded, cargo and passengers secured, and weight and balance verified per Chapter 6, WEIGHT/BALANCE, and LOADING. This aircraft requires a weight and balance clearance for each flight per AR 95-16. Weight and center of gravity conditions must be within limits prescribed in Chapters 5, OPERATING LIMITS AND RESTRICTIONS.

8-4. Performance.

Refer to Chapter 7, PERFORMANCE DATA, to determine the capability of the aircraft for the entire mission. Consideration must be given to changes in performance resulting from variation in loads, temperatures, and pressure altitudes. Record the data on the Performance Planning Card for use in completing the flight plan and for reference throughout the mission.

8-5. Flight Plan.

A flight plan must be completed and filed per AR 95-1, DOD FLIP, and local regulations.

8-6. Crew and Passenger Briefings.

A crew/passenger briefing must be conducted for a thorough understanding of individual and team responsibilities. The briefing should include, but not be limited to, copilot, crew chief, ground-crew responsibilities, and the coordination necessary to complete the mission most efficiently. A review of visual signals is desirable when ground guides do not have a direct voice communications link with the crew. Refer to Section VI for crew and passenger briefings.

SECTION II. OPERATING PROCEDURES AND MANEUVERS

8-7. Operating Procedures and Maneuvers.

a. This section deals with normal procedures and includes all steps necessary for safe and efficient operation of the aircraft from the time a preflight begins until the flight is completed and the aircraft is parked and secured. Unique feel, characteristics, and reaction of the aircraft during various phases of operation and the techniques and procedures used for taxiing, takeoff, climb, etc., are described, including precautions to be observed. Only the duties of the minimum crew necessary for the actual operation of the aircraft are included.

b. Procedures specifically related to instrument flight that are different from normal procedures are covered in this section following normal procedures. Descriptions of functions, operations, and effects of controls are covered in Section IV, FLIGHT CHARACTERISTICS, and are repeated in this section only when required for emphasis. Checks that must be performed under adverse environmental conditions such as desert and cold weather operations supplement normal procedures checks in this section and are covered in Section V, ADVERSE ENVIRONMENTAL CONDITIONS.

8-8. Symbols Definition.

Items which apply only to night or only to instrument flying shall have an "N" or an "I", respectively, immediately preceeding the check to which it is pertinent. The symbol "O" shall be used to indicate "if installed". Those duties which are the responsibility of the copilot, will be indicated by a circle around the step number i.e., ⑤ Starter and IGN SYS circuit breakers - IN. The symbol star "★" indicates an operational check is required. Operational checks are contained in the performance section of the condensed checklist. The symbol asterisk "*" indicates that performance of the step is mandatory for all thru-flights, when there has been no change in crew. The asterisk applies only to checks performed prior to takeoff. Placarded items appear in upper case.

8-9. Checklists.

Normal procedures are given primarily in checklist form and are amplified as necessary in accompanying paragraph form when a detailed description of a procedure or maneuver is required. A condensed version of the amplified checklist, omitting all explanatory text, is contained in the Operator's and Crewmember's Checklist, TM 55-1510-209-CL. To provide for easier cross referencing, the procedural steps are numbered to coincide with the corresponding numbered steps in this manual.

8-10. Checklist Callout.

Pilot and crewmembers shall not rely on memory for verifying prescribed operational checks, except those immediate action emergency procedures that must be memorized for safe aircraft emergency operation. Oral callout and confirmation of checklist items shall be accomplished by pilot and the crewmembers.

8-11. Preflight Check.

The preflight check is performed as follows:

NOTE

If ferry fuel system is used, refer to Chapter 2 for complete operating procedures and emergency procedures.

a. Before Exterior Check.

*1. Publications - Check DA Forms 2408-12, -13, -14 and availability of DOD AVFUEL Identaplate DD Form 1896, Operator's Manual (-10), Checklist (-CL) and locally required forms and publications.

2. Oxygen cylinder pressure valves - OPEN.

*3. Oxygen system pressure - Check.

4. Keylock switch - OFF.

5. Firewall shutoff valves - OPEN and safetied.

CAUTION

If high or gusty winds are present, and the flight controls are unlocked, control surfaces may be damaged by buffeting.

*6. Flight controls - Unlocked.

*7. Parking brake - Set.

8. Trim tabs - Zero.

*9. AVIONICS MASTER switch - OFF.

CAUTION

Do not cycle landing gear handle on the ground.

*10. Gear handle - DN.

*11. Battery - ON (stabilized, 22 volts minimum).

12. Strobe beacons - Check illumination.

★ *13. Pitot, stall warning, fuel vent and battery vent heat systems - Check.

(1) Pitot and stall warning heat switch - ON (check pitot cover removed).

(2) Fuel vent heat switches (2) - ON.

(3) Pitot tube - Check by feel for heat and free of obstructions.

(4) Stall warning vane - Check by feel for heat, condition and operation.

(5) Fuel vents (2) - Check by feel for heat and free of obstruction.

(6) Battery vent - Check by feel for heat and free of obstructions.

(7) Pitot and stall warning heat switch - OFF.

(8) Fuel vent heat switches (2) - OFF.

14. Lighting systems - Check as required.

15. Battery - OFF.

16. Safety belts, shoulder harnesses, inertia reels - Check condition and operation.

17. Fire extinguishers (2) - Check.

18. Fire axe - Secured.

19. First aid kits (5) - Check.

b. Exterior Check (fig. 8-1).

NOTE

Fuel and oil quantity check may be performed prior to EXTERIOR CHECK to preclude carrying ladder around during the inspection.

**(1) Fuel sample - Check collective fuel sample for contamination.*

WARNING

If fuel is detected at transfer pump or boost pump seal drain tube, a fire hazard exits.

(2) Left Wing.

1. Skin condition - Check for skin damage such as buckling, cracking, splitting, distortion, dents, or fuel leaks.

2. Controls, flaps and trim tab - Check hinge attachment and trim tab rig.

3. Static wicks - Check for security of discharge wicks.

4. Wing tip and navigation light - Check.

5. Landing light - Check.

*6. Tiedown - Released

7. Fuel vent - Check flush vent free of obstructions.

*8. Wing tank fuel and cap - Check fuel level visually. Check seal is installed, cap is tight and properly installed (latch tab aft).

9. Deicer boot - Check bonding secure, boot free of cuts and cracks, stall strips installed and secure.

10. Wing ice light - Check.

11. Fuel vents (2) - Check heated and recessed vents free of obstructions.

12. Inverter air intake screen and exhaust port - Check free of obstructions.

(3) Left main landing gear.

*1. Tire - Check for cuts, bruises, wear, and proper inflation.

2. Brake assembly - Check brake lines for damage or signs of leakage, and brake linings for wear.

*3. Shock strut - Check for signs of leakage and 2.75 INCH EXTENSION (MINIMUM), left and right strut extension approximately equal.

4. Torque knee - Check.

5. Safety switch - Check.

6. Wheel well general condition - Check.

*7. Doors and linkage - Check.

8. Air bypass and oil cooler (rear)- Check free of obstructions and oil leaks.

9. Firewall fuel filter drain (at inertial separator duct) -Turn/release. Check for fuel drainage.

(4) Left engine and propeller.

1. Accessory section exhaust vent - Check free of obstructions.

2. Left cowl locks - Locked.

3. Left exhaust stub - Check for cracks and security.

*4. Propeller blades and spinner - Check blades for nicks, security of spinner and free rotation.

*5. Nacelle air intake - Check free of obstructions.

6. Nacelle lip ice boot - Check condition and security.

*7. Oil cooler air intake - Check free of obstructions and leakage.

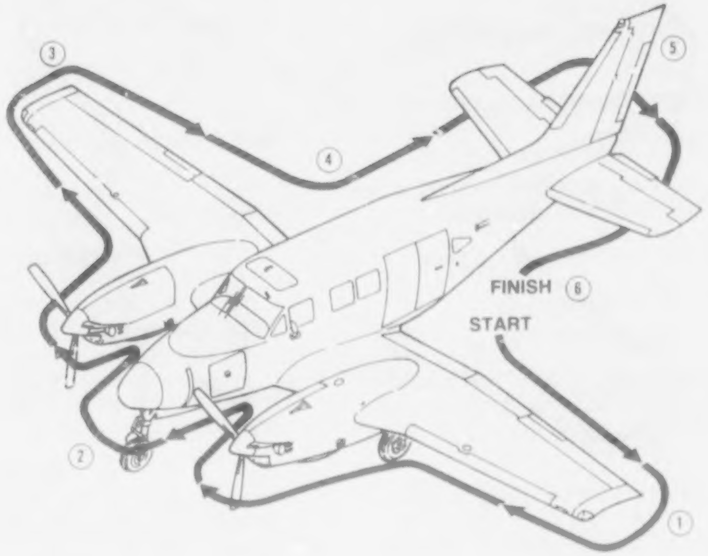


Figure 8-1. Exterior Check

8. Right cowl locks - Locked.

9. Right exhaust stub - Check for cracks and security.

CAUTION

A cold oil check is unreliable. If the oil level is LESS THAN 3 QUARTS LOW, the oil quantity is sufficient to operate the engine for a total fuel duration, unless engine oil consumption is excessive or a leak exists. Do not add oil. However, if cold oil check indicates MORE THAN 3 QUARTS LOW, motor engine 15 to 20 seconds then recheck and add as required. Do not overfill.

*10. Engine compartment - Check for fuel and oil leaks, oil level and positively secure oil cap (latch tab aft).

*11. Nacelle tank fuel and cap - Check fuel level visually. Check seal is installed, cap is tight and properly installed (latch tab aft).

(O) *12. Fuel filter drain ring - Pull/release. Check for fuel drainage.

*13. Engine compartment access door - Locked. Visually check locking hooks.

(5) Fuselage underside.

1. General condition - Check.

2. Antennas - Check for security.

3. Strobe beacon - Check condition.

(6) Left nose avionics compartment.

(O)1. Voice security computer - Installed/keyed.

(O)2. Transponder computer - Installed/keyed.

(O)3. Transponder - Set M-2 code.

4. Left nose avionics compartment access door - Secured.

(7) Nose section.

1. Wheel well general condition - Check.

2. Doors and linkage - Check.

3. Nose gear turning stop - Check condition.

*4. Tire - Check for cuts, bruises, wear, and proper inflation.

5. Torque knee - Check.

*6. Shock strut - Check for signs of leakage and a 2.75-INCH EXTENSION (MINIMUM).

7. Shimmy damper and attaching linkage - Check.

8. Taxi light - Check.

9. Radome - Check.

10. Windshield and wipers - Check.

11. Ram air intake - Check free of obstructions.

12. Ram air intake lip ice boot - Check security and condition.

13. Right nose avionics compartment access door - Secured.

14. Battery Compartment access panel - Secured (top and bottom).

(8) Right engine and propeller.

1. Accessory section exhaust vent - Check free of obstructions.

2. Left cowl locks - Locked.

3. Left exhaust stub - Check for cracks and security.

*4. Propeller blades and spinner - Check blades for nicks, security of spinner and free rotation.

*5. Nacelle air intake - Check free of obstructions.

6. Nacelle lip ice boot - Check condition and security.

*7. Oil cooler air intake - Check free of obstructions and leakage.

8. Right cowl locks - Locked.

9. Right exhaust stub - Check for cracks and security.

*10. Engine compartment - Check for fuel and oil leaks, oil level level and positively secure oil cap (latch tab aft).

*11. Nacelle tank fuel and cap - Check fuel level visually. Check seal is installed, cap is tight and properly installed (latch is aft).

(O) *12. Fuel filter drain ring - Pull/release. Check for fuel drainage.

*13. Engine compartment access door - Locked. Visually check locking hooks.

(9) Right main landing gear.

*1. Tire - Check for cuts, bruises, wear, and proper inflation.

2. Brake assembly - Check brake lines for damage or signs of leakage, and brake linings for wear.

*3. Shock strut - Check for signs of leakage and a 2.75-INCH EXTENSION (MINIMUM).

4. Torque knee - Check.

5. Safety switch - Check.

6. Wheel well general condition - Check.

*7. Doors and linkage - Check.

8. Air bypass and oil cooler (rear) - Check free of obstructions and oil leaks.

(O) *9. Firewall fuel filter drain (at inertial separator duct) - Turn/release. Check for fuel drainage.

(10) Right wing.

1. Inverter air intake screen and exhaust port - Check free of obstructions.

2. Fuel vents (3) - Check heated, recessed and flush vents free of obstruction.

3. Heated battery vent - Check for condition and security.

4. Wing ice light - Check.

5. Deicer boot - Check bonding secure, boot free of cuts and cracks.

*6. Wing tank fuel and cap - Check fuel level visually. Check seal is installed, cap is tight and properly installed (latch tab aft).

*7. Tiedown - Released.

8. Landing light - Check.

9. Wing tip and navigation light - Check.

10. Static wicks - Check for security of discharge wicks.

11. Controls, flaps, and trim tab - Check hinge attachment and trim tab rig.

12. Skin condition - Check for skin damage, such as buckling, cracking, splitting, distortion, dents or fuel leaks.

(11) Fuselage right side.

1. Skin condition - Check for skin damage, such as buckling, cracking, splitting, distortion or dents.

2. Cabin air exhaust vents - Check free of obstructions.

*3. Antennas - Check for security.

4. Static port - Check, free of dirt or obstructions.

*5. Tiedown - Released.

(O) *6. Tail stand - Removed.

(12) Empennage.

1. Right horizontal stabilizer deicer boot - Check bonding secure, boot free of cuts and cracks.

2. Right horizontal stabilizer - Check security, cracks and skin condition.

3. Static wicks - Check for security of discharge wicks.

4. Right elevator and trim tab - Check security and condition. Verify neutral position of trim tab.

5. Navigation and beacon lights - Check condition.

6. Rudder and trim tab - Check security and condition.

7. Vertical stabilizer - Check skin condition.

8. Left elevator and trim tab - Check security and condition. Verify neutral position of trim tab.

9. Static wicks - Check for security of discharge wicks.

10. Left horizontal stabilizer - Check security, cracks and skin condition.

11. Left horizontal stabilizer deicer boot - Check bonding secure, boot free of cuts and cracks.

12. Vertical stabilizer deicer boot - Check bonding secure, boot free of cuts and cracks.

(13) Fuselage left side.

1. Static port - Check for freedom from dirt or obstructions.

2. Cabin air exhaust vent - Check free of obstructions.

3. Skin condition - Check for skin damage, such as buckling, cracking, splitting, distortion or dents.

4. Main entrance and cargo doors - Check.

5. Chocks - Removed.

c. *Interior Check.*

1. Ladder - Stowed.

*2. Cargo/loose equipment - Secured.

*3. Cargo door - LOCK.

*4. Main entrance door - LOCK.

5. Cabin emergency exit hatch - Secured (safety seal intact).

★ *6. Crew/passenger briefing - As required (Section VI).

8-12. Before Starting Engines.

*1. Seats, pedals, belts, harnesses - Adjust.

2. Cockpit emergency entrance/exit hatch - Secured (safety seal intact).

3. Overhead control panel switches - Set.

4. Magnetic compass - Check for fluid, heading, and correction card.

5. Free air temperature gage - Note current reading.

6. Fire detection test switch - OFF.

NOTE

Movement of the power levers to the full forward position with the condition levers in the FUEL CUTOFF position may result in bending and possible damage to common linkage.

*7. Power levers - IDLE.

CAUTION

Do not position the power levers into the REVERSE range while engines are shut down. Damage to the reversing linkage will result.

*8. Propeller levers - HIGH RPM.

*9. Condition levers - FUEL CUTOFF.

10. Flaps - UP.

11. Emergency landing gear clutch disengage lever - Stowed.

12. Landing gear emergency extension handle - Stowed.

13. Fuel system circuit breakers - Check in.

14. Boost pumps - OFF.

15. Transfer pumps - OFF.

16. Crossfeed - CLOSED.

17. Pilot's flight instruments - Check for correct readings.

18. Engine instruments - Check placards and slippage marks.

19. Copilot's flight instruments - Check for correct readings.

20. Emergency static air source - NORMAL.

21. Copilot's circuit breaker panel - Check circuit breakers in.

22. Right subpanel circuit breakers - Check in.

23. Heater - OFF.

24. Gear handle - DN.

25. Windshield anti-ice switches - OFF.

26. Left subpanel light switches (4) - OFF.

27. Deice cycle switch - Centered (off).

28. Autofeather system - OFF.

29. Heat switches (8) - OFF.

30. Landing lights - OFF.

31. Engine ice vanes - As required.

32. Ignition/start switches (2) - STOP.

33. Engine autoignition - OFF.

34. Inverters - OFF.

*35. DC GPU - Connect as required.

*36. Battery - ON.

*37. Voltage - Check (28 VDC maximum).

*38. Annunciator panel - Test.

(N) *39. Navigation lights - ON.

*40. Landing gear handle lights (2) - Test.

41. Landing gear down indicator lights (3) - Illuminated.

42. Keylock switch - ON.

*43. Fire detection system - Test. Verify warning horn sounds; simultaneously the red FAULT WARN light flashes and LH and RH FIRE WARN lights illuminate in each (3) numbered fire detection system test switch positions.

NOTE

A ground test of the engine fire detection system insures electrical continuity within the system.

44. MASTER WARNING button - Press FAULT WARN light should extinguish.

*45. Generators - OFF.

8-13. *Starting Engines (Battery/GPU).

A GPU will be used for engine starting whenever possible. When making a battery start, start the right engine first (starting circuit is shorter).

CAUTION

For a GPU start, it is recommended to start the left engine first, as the GPU receptacle is located on the underside of the right wing outboard of the engine.

CAUTION

Monitor ITT to avoid a hot start. If there is a rapid rise in ITT, be prepared to abort the start before limits are exceeded. During engine start, the maximum allowable ITT is 1090°C for two seconds. If this limit is exceeded, use ABORT START procedure and record the peak temperature and duration on DA Form 2408-13.

If ignition does not occur within 10 seconds after moving the condition lever to LO IDLE, initiate ENGINE CLEARING PROCEDURES. If for any reason a starting attempt is discontinued, the entire sequence must be repeated after allowing the engine to come to a complete stop.

If the N_1 tachometer immediately indicates above 20%, discontinue the start.

Do not exceed limitation of 40 seconds on, and 60 seconds off for two starter operations; then 40 seconds on, 30 minutes off.

a. Start Procedure.

1. Strobe beacon switches (2) - As required.

(N)2. Navigation lights - ON.

3. Boost pumps (2) - ON. Check both BOOST FAIL lights extinguished.

4. Propeller - Clear (Fig. 8-2, Exhaust Danger Area).

5. Ignition/start switch - ON (check IGN ON light illuminated).

6. Condition lever - LO IDLE (after N_1 stabilizes at or above 12% for 5 seconds).

7. ITT - Monitor **(1090°C FOR TWO SECONDS MAXIMUM FOR ENGINE BEING STARTED, 750°C MAXIMUM FOR OPERATING ENGINE).**

8. Ignition/start switch - Stop after ITT has stabilized. IGN ON light extinguished.

9. Condition lever - HIGH IDLE.

10. Generator (for battery start) - ON. GEN OUT light extinguished.

11. Inverter - Right. Check AC OUT lights (3) extinguished.

12. Fuel pressure - Check **(15 PSI MINIMUM).**

13. Oil pressure - Check **(40 PSI MINIMUM).**

14. Inverter - OFF.

15. GPU - Disconnect.

16. Generator - ON. Check GEN OUT light extinguished.

17. Loadmeter - Monitor **(0.5 MAXIMUM).**

18. Second engine - Start, steps 4 through 8 above.

19. Generator - ON. Check GEN OUT light extinguished.

20. Inverters - LEFT. Check AC OUT lights extinguished.

21. Condition levers - LO IDLE.

22. Fuel control heat switches (2) - ON.

b. Abort Start.

1. Condition lever - FUEL CUTOFF.

2. Ignition/start switch - STARTER ONLY.

3. ITT - Monitor for drop in temperature.

4. Ignition/start switch - STOP.

c. Engine Clearing.

1. Condition lever - FUEL CUTOFF.

2. Ignition/Start switch - STOP (allow 30 seconds delay).

3. Ignition/start switch - STARTER ONLY (30 to 40 seconds).

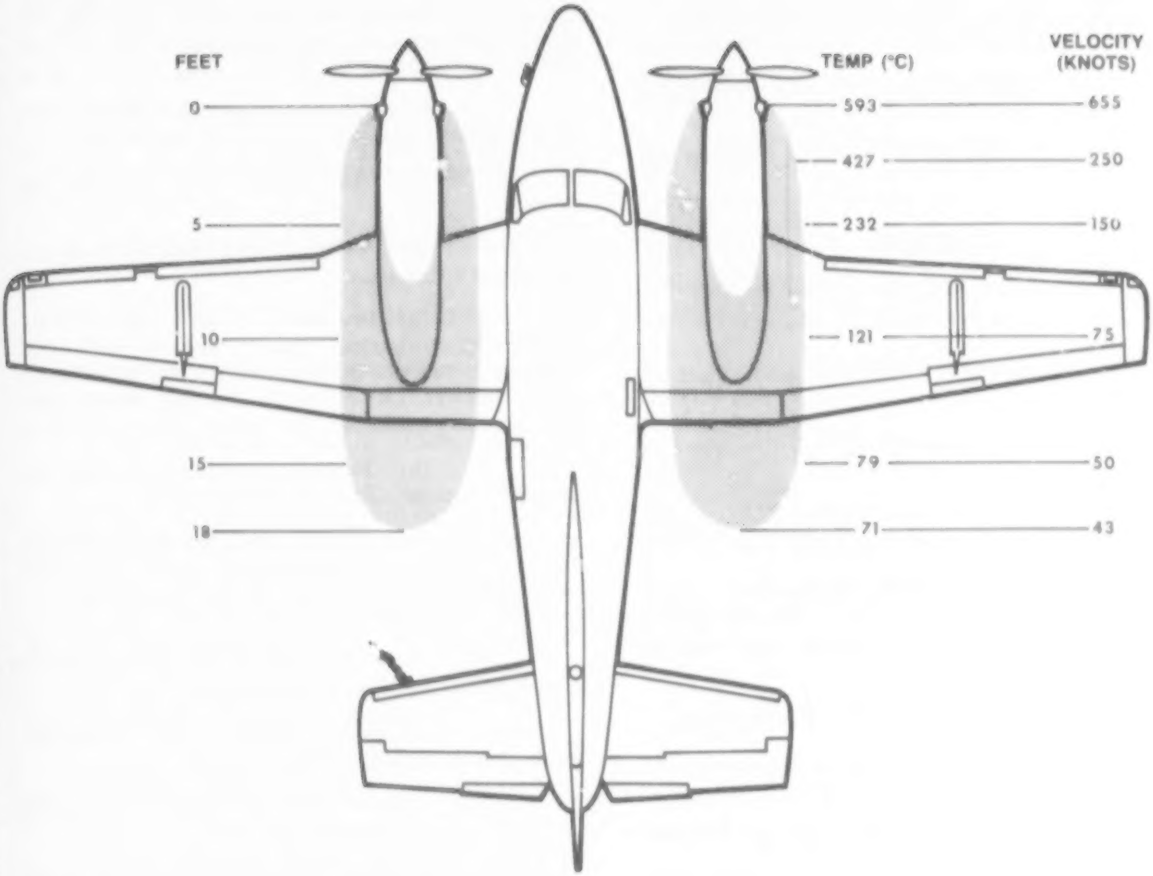
4. Ignition/Start switch - STOP.

8-14. *Before Taxiing.

1. AVIONICS MASTER switch - ON.

2. Radios - ON. Communication and navigation radios ON, radar and transponder STBY.

★(I)3. Windshield anti-ice operation - Check. The electrothermal windshield will prevent initial ice adhesion to the glass but will not remove ice already formed on the windshield. Therefore anti-icing


FEET
0
5
10
15
18
TEMP (°C)
593
427
232
121
79
71
VELOCITY (KNOTS)
655
250
150
75
50
43

▨ EXHAUST DANGER AREA (MAX. POWER, STATIC CONDITION)

NOTE

THE EXHAUST DANGER AREA DOES NOT INCLUDE PROPELLER WAKE WHICH INCREASES VELOCITY, AND SIGNIFICANTLY REDUCES TEMPERATURE.

EXHAUST GAS TEMPERATURE AND VELOCITY AT GROUND IDLE IS VERY LOW, HOWEVER, THE IMMEDIATE AREA OF EXHAUST DISCHARGE SHOULD BE AVOIDED.

AV 095711

Figure 8-2. Exhaust Danger Area

conditions. When glass temperature exceeds 43°C, operational checks of the electrothermal windshields will be unreliable.

(1) Pilots windshield anti-ice switch - ON. (Watch volt-loadmeter for a slight increase.)

(2) Copilot's windshield anti-ice switch - ON. (Confirm additional meter loads.)

(3) Reposition switches as required for flight.

NOTE

The magnetic compass is erratic when the windshield anti-ice system is on.

★ 4. Autopilot/electric trim system - Check as follows:

(1) Verify that all autopilot modes are disengaged.

(2) Preflight TEST button (autopilot mode control panel) - Press and hold.

(3) Autopilot mode annunciator panel displays - Check all illuminated. TRIM display should flash at least four times, but no more than six times.

(4) Aural trim alert - Listen for sound.

(5) Yaw damp indicator light (autopilot mode control panel) - Check illuminated.

(6) ARM and ALERT display (altitude selector panel) - Check displayed.

(7) Computer flag (pilot's flight director indicator) - Check in view.

(8) Preflight TEST button (autopilot mode control panel) - Release.

(9) Manual electric trim system - Check as follows:

(a) PITCH TRIM switch (pilot's control wheel) - Move the left side of the trim switch to the forward and aft position, while moving the pitch-trim control wheel. The pitch-trim solenoid should engage, making it more difficult to move the pitch-trim control wheel, but the electric trim motor should not run. Move the right side of the trim switch to the forward and aft positions. The pitch-trim solenoid should not engage and the electric trim motor should not run.

(b) Overpower capability - Check by moving the pilot's PITCH TRIM switch to the forward and aft positions while holding the manual pitch-trim control wheel.

(c) TRIM TEST switch (pedestal extension) - Depress and hold while operating the electric trim up and down using the pilot's PITCH TRIM switch (control wheel).

(d) TRIM annunciator display (autopilot annunciator panel) - Check displayed.

(e) Aural trim alert - Listen for sound.

(f) TRIM TEST switch (pedestal extension) - Release.

(g) Autopilot AP DISC/TRIM INTER switch (control wheel) - Depress and hold. Attempt to run the electric trim up and down using pilot's PITCH TRIM switch (control wheel). The trim system should not run either UP or DOWN.

(h) Repeat steps (a) through (e) using the copilot's PITCH TRIM switch.

(i) Pilot's and copilot's PITCH TRIM switches - Simultaneously move the pilot's switch forward and the copilot's switch aft. The electric trim should run up.

(10) Flight director switch (FD) (autopilot mode control panel) - Press on.

(11) Autopilot switch (AP) (autopilot mode control panel) - ON.

(12) Control wheel steering switch (CWS) (control wheel) - Depress and hold.

(13) Control wheel - Manually move to neutral position.

(14) Control wheel steering switch (CWS) - Release.

(15) Control wheel - Apply force to all axes. Determine that autopilot can be overpowered.

(16) Autopilot AP DISC/TRIM INTER (control wheel) - Depress to disconnect autopilot.

(17) Manual trim - Set for takeoff.

(18) Autopilot switch (AP) (autopilot mode control panel) - ON.

(19) ROLL TEST switch (control pedestal) - Hold to LT position for approximately two seconds. Autopilot should disconnect and the aural alert should sound.

(20) Autopilot switch (AP) (autopilot mode control panel) - ON.

(21) ROLL TEST switch (control pedestal) - Hold to RT position for approximately two seconds. Autopilot should disconnect and the aural alert should sound.

(22) Autopilot switch (AP) (autopilot mode control panel) - ON.

(23) PITCH TEST switch (control pedestal) - Hold to UP position for approximately two seconds. Autopilot should disconnect and the aural alert should sound.

(24) Autopilot switch (AP) (autopilot mode control panel) - ON.

(25) PITCH TEST switch (control pedestal) - Hold to DN position for approximately two seconds. Autopilot should disconnect and the aural alert should sound.

(26) Autopilot switch (AP) (autopilot mode control panel) - ON.

(27) Vertical trim control (autopilot mode control panel) - Move to insert a pitch-up command.

(28) Control wheel - Hold to keep from moving and observe that the trim wheel moves in the nose up direction after a three second delay.

(29) Control wheel steering switch (CWS) (control wheel) - Depress momentarily.

(30) Vertical trim control (autopilot mode control panel) - Move to insert a pitch-down command.

(31) Control wheel - Hold to keep from moving and observe that the trim wheel moves in the nose down direction after a three second delay.

(32) Control wheel steering switch (CWS) (control wheel) - Depress and center the control wheel about the roll axis, then release.

(33) Heading switch (HDG) (autopilot mode control panel) - Press on

(34) Heading select bug (horizontal situation indicator) - Set bug to command a right turn. The control wheel should rotate clockwise.

(35) Heading select bug (horizontal situation indicator) - Set bug to command a left turn. The control wheel should rotate counterclockwise.

(36) Autopilot switch (AP) (autopilot mode control panel) - OFF.

(37) Flight director switch (FD) (autopilot mode control panel) - Disengage.

(38) PITCH TRIM switch (control wheel) - Move aft until a full nose-up trim position has been attained, then move switch forward and simultaneously begin timing. When the full nose-down trim position has been attained release switch and note time. The time required for trim system to run from full nose up to full nose down should be 45 ±9 seconds.

(39) If the autopilot fails the preflight test, the AUTOPILOT circuit breaker must be pulled. However, manual electric trim may still be used. If the electric trim system fails the preflight test, the ELEC TRIM circuit breaker must be pulled and neither the electric trim nor the autopilot may be used.

★ 5. Oxygen system - Check as required.

(1) Cockpit oxygen supply valve (left cockpit sidewall) - As required.

(2) Cabin oxygen supply valve (left cockpit sidewall) - As required.

(3) Oxygen supply pressure gage (left cockpit sidewall) - Check.

(4) Oxygen supply pressure gage (regulator control panel) - 300 to 400 PSI.

(5) Supply control lever (green) - ON.

(6) Diluter control lever (white) - 100% OXYGEN.

(7) Emergency pressure control lever (red) - NORMAL.

(8) Oxygen mask hose - Connect to mask hose connection.

(9) Emergency pressure control lever (red) - Set to TEST MASK position while holding mask away from your face, then return lever to NORMAL.

(10) Oxygen mask - Put on and adjust to face.

(11) Emergency pressure control lever (red) - Set to TEST MASK position and check mask for leaks, then return lever to NORMAL.

(12) Flow indicator - Check (during inhalation blinker appears, during exhalation blinker disappears). Repeat a minimum of 3 times.

6. Radios - Check intercom, communication and navigation systems and radar.

7. Taxi clearance - Check.

8. Clock - Set.

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9. Altimeters - Set.

10. Parking brake - Release.

8-15. *Taxiing.

1. Brakes - Check.

2. Flight instruments - Check settings and operation.

8-16. Engine Runup.

Turn the aircraft into the wind if possible, and perform the following checks:

*1. Nose wheel - Centered.

NOTE

The nose wheel cannot be straightened with rudder pedals when the aircraft is stopped.

*2. Parking brake - Set (keep feet on rudder pedals).

NOTE

The parking brake can be set only from the pilot's seat.

*3. Power levers - IDLE.

*4. Condition levers - LO IDLE.

★ *5. Manual crossfeed - Check by setting switch to OPEN. Check FUEL CROSSFEED light illuminates, then set switch to AUTO. Check FUEL CROSSFEED light is extinguished.

★ 6. Fuel system crossfeed operation - Check as follows:

(1) Crossfeed switch - AUTO.

(2) Left boost pump - OFF.

(3) Annunciator panel - Monitor. Left boost pump fail light and fuel crossfeed lights must come on.

(4) Fuel pressure - Check (both engines).

(5) Left boost pump - ON.

(6) Crossfeed - CLOSED.

(7) Crossfeed - AUTO.

(8) Repeat procedure for right boost pump.

NOTE

Whenever the FUEL CROSSFEED light illuminates due to the start of automatic crossfeed, the light will not extinguish until the "FT-LB" crossfeed switch is reset to CLOSED. Afterwards, the switch may be reset to AUTO and the light will remain extinguished.

★ *7. Fuel transfer pumps - Check as follows:

(1) Transfer test switch - Hold to "R".

(2) Right transfer pump switch (while watching annunciator panel) - ON.

(3) NO FUEL TRANSFER light - Check for momentary flash.

NOTE

Steady illumination, or lack of momentary flash, indicates a transfer pump system fault. For system fault recheck, switch transfer pump OFF for 5-10 seconds and repeat fuel transfer pump check. The momentary flash may not be detected if the cockpit lights are on.

(4) Repeat procedure for left transfer pump system.

8. Flaps - Check operation of 4 panels and flap position indicator.

★ 9. Propeller manual feather - Check (with power levers at IDLE) by pulling propeller levers aft through detent to FEATHER. Check that propeller will feather, then advance lever to HIGH RPM.

★(O)10. Engine autoignition system - Check.

(1) Power levers - Advance to **ABOVE 450 FT-LBS TORQUE.**

(2) Autoignition - ARM (check green IGNITION ARM lights illumninated).

(3) Power levers - Retard to **LESS THAN 350 FT-LBS TORQUE** (annunicator L and R IGN ON lights illuminated, green IGNITION ARM lights extinguished).

(4) Autoignition - OFF.

(5) Power levers - IDLE.

★ 11. Propeller autofeather system - Check.

(1) Power levers - IDLE.

(2) Autofeather test switch - TEST. Check AUTOFEATHER lights do not illuminate, and propellers do not feather.

(3) Power lever - Advance to **500 FT-LBS TORQUE.**

(4) Autofeather test switch - TEST. Hold to test position and check both AUTOFEATHER lights illuminated; retard one power lever. **AT 350 TO 450 FT-LBS TORQUE**, check opposite AUTOFEATHER light extinguished. **AT 160 TO 290 FT-LBS TORQUE**, check both AUTOFEATHER lights extinguished; check propeller starts to feather.

NOTE

AT 160 TO 290 FT-LBS TORQUE setting, AUTOFEATHER light may flicker.

(5) Power lever - Return to **500 FT-LBS TORQUE.**

(6) Repeat steps (4) and (5) using the other power lever.

(7) Propeller autofeather test switch - ARM.

(8) Both power levers - Advance to **88 TO 92% N_1** (observe ITT and torque limits). Check both AUTOFEATHER lights illuminated. Retard each power lever individually below **88 TO 92% N_1**. Check both AUTOFEATHER lights extinguished.

NOTE

If the aircraft is to be flown with a defective autofeather system, the prop feather circuit breaker should be pulled and the AUTOFEATHER switch should be positioned to OFF.

★ 12. Overspeed governor - Check. Set prop RPM to 2100. Hold PROP GOV TEST switches UP. RPM should **DECREASE TO 1980 TO 2060.** Release test switches. RPM should return to 2100.

CAUTION

Do not exceed ITT or torque limits.

13. Engine ice vanes (left and right) - Pull to EXT. Check operation by observing drop in torque reading, verify that handle remains extended when released; then, push to RET.

NOTE

Loosen friction knobs prior to primary governor and secondary idle stop check to provide better feel.

★ 14. Primary governor - Check. Set 1900 RPM with power levers. Retard propeller levers to detent position. **CHECK FOR 1725 TO 1775 RPM**, then advance propeller levers to HIGH RPM.

CAUTION

To prevent damage to reversing linkage, do not force power levers to full REVERSE with test switch ON.

★ 15. Secondary idle stop - Check, with condition levers at HIGH IDLE and power levers at IDLE; then, while holding the SECONDARY IDLE STOP switches DOWN, move power levers slowly toward REVERSE in one continuous movement, while observing that SECONDARY LOW PITCH STOP lights illuminate and an **RPM RISE OF 170 TO 250 RPM** is obtained. Release the test switch and RPM should increase. Return power levers to normal idle position and cancel lights in annunciator panel by actuating secondary flight idle test switch, if they remain illuminated.

16. Instrument air pressure - Check **(1.8 to 2.05 in. Hg.).**

17. Volt-loadmeters - Check BUS voltage **BETWEEN 26.5 AND 29.5 VOLTS (MAX)**, and load paralleling within one increment and a maximum of 0.5 on the loadmeter scale. Enter any discrepancy on DA Form 2408-13.

(I) 18. Propeller deice system - Check. Move the switch to PROP position and check propeller ammeter normal operation (14-18 amperes) for 2.5 minutes. Flickering of the propeller deicing ammeter needle may or may not be detectable during cycle switching.

(I) 19. Surface deice system - Check by activating the deice switch to SINGLE and visually check inflation and deflation of boots and PNEUMATIC PRESSURE. Repeat procedure for MANUAL switch position.

NOTE

The deicing system should be actuated on a daily basis to ensure system function and to exercise the system distributor valve.

8-17. *Before Takeoff.

1. Fuel panel - Check switches and circuit breakers set.

2. Annunciator panel - Check (lights extinguished).

3. Engine and flight instruments - Check.

4. Propeller levers - Check HIGH RPM.

5. Friction locks - Set.

6. Flaps - UP.

WARNING

Insure that the autopilot has been disengaged and check that the aircraft manual trim indicator is set to the takeoff position before takeoff. Operating the autopilot on the ground may cause the autotrim to run because of back force generated by the elevator down springs or pilot induced forces.

7. Autopilot - OFF.

8. Flight director - As required.

9. Trim - Check set for takeoff.

10. Engine ice vanes - Retracted.

11. Fuel control heat - Check ON.

12. Autofeather switch - Check ARM.

(I) 13. Navigation radios - Set.

14. Flight controls - Check for full travel and proper response.

15. Windows and doors - Secure.

16. Mirror - Retracted.

(I)17. Anti-icing/deicing/pitot heat - As required.

8-18. *Lineup.

1. Transponder - As required.

NOTE

To prevent zeroizing the MODE 4 function of the AN/APX-72 transponder, when the landing gear is down (struts compressed) and either transponder or aircraft power is to be turned off, place the CODE switch momentarily in HOLD position.

2. Gyro heading - Check.

NOTE

Prior to flight, the gyro magnetic compass indicator should be cross-checked with the magnetic compass to verify approximate heading as the indicator annunciator window will also be clear (blank) if the heading is 180° out of phase.

3. Power - Stabilized (70-80% N_1).

NOTE

AUTOFEATHER system arm lights should illuminate at 88 to 92% N_1. This is to assure autofeather arming at takeoff torque.

4. Autoignition - As required.

(N)5. Landing/strobe and/or taxi lights - As required.

8-19. Takeoff.

WARNING

Minimum run takeoff is a contingency maneuver and may be performed below V_{mc} and below power-off stall speed. Control of the aircraft may be lost if engine failure occurs at or immediately following liftoff or until the best angle of climb speed can be obtained.

CAUTION

To prevent damage to the landing gear retraction mechanism, brakes should not be applied to slow down the rotation of the tires while retracting the landing gear or after gear is up. A rubberized drag brake shoe is provided in the wheel well to stop the wheels from rotating after retraction.

To aid in planning takeoff and to obtain maximum aircraft performance, refer to chapter 7.

a. Normal Takeoff. Apply takeoff power. Maintain directional control with nosewheel steering and rudder while maintaining wings level with ailerons. Use of differential power at the beginning of takeoff roll will assist in directional control. Rotate at (V_r) and allow aircraft to accelerate to the desired climb airspeed. Rotation should be at a rate that will allow liftoff at the liftoff speed.

b. Crosswind Takeoff. Position the aileron control into the wind at the start of the takeoff roll. Leading with upwind power at the beginning of the takeoff roll will assist in maintaining directional control.

c. Minimum Run Takeoff. Minimum run takeoffs are performed with APPROACH flaps. After the lineup check is completed, set takeoff power and release brakes. As soon as elevator control becomes effective (approximately 50 KIAS), raise the nose wheel clear of the runway. Continue to apply elevator pressure in a smooth continuous motion until clear of the runway, then lower nose and accelerate to desired climb speed. Monitor ITT and torque. Retract the landing gear when flight is assured.

d. Obstacle Clearance Climb. Follow procedures as outlined for a minimum run takeoff, to the point of actual liftoff. When airborne, retract the landing gear and establish a wings-level climb attitude, maintaining the computed best angle-of-climb speed (V_x). Climb at this speed until clear of the obstacle. After the obstacle is cleared, accelerate to an airspeed equal to or exceeding best rate-of-climb airspeed (V_y). Retract flaps after attaining single-engine best rate-of-climb airspeed (V_{yse}).

8-20. After Takeoff.

CAUTION

Retract landing gear below 127 KIAS. Additional airspeed imposes excessive air loads on the gear retraction mechanism.

1. Gear - UP.

2. Flaps - UP.

3. Climb power - Set.

4. Autofeather system - OFF.

5. Flight director/yaw damp switch - As required.

6. Wings and nacelles - Check for fuel and oil leaks.

7. Landing/taxi lights - As required

8-21. Climb - Normal.

Refer to chapter 7 for normal climb speeds.

8-22. Climb - Max Rate.

Refer to chapter 7 for maximum rate of climb speeds.

8-23. Cruise Checks.

Refer to chapter 7, for the necessary flight planning information. Refer to chapter 2 for necessary fuel system management. The following procedures are applicable to all cruise requirements.

CAUTION

Maximum turbulent air penetration speed is 168 KIAS.

1. Power - Set RPM. Do not exceed maximum cruise-torque settings in chapter 7.

2. Wings and nacelles - Checked for fuel and oil leaks.

8-24. Fuel System Crossfeed.

Refer to chapter 9 for fuel system crossfeed emergency procedures.

8-25. Descent.

1. Descent - Max Rate (Clean).

   (1) Power - IDLE.

   (2) Propellers - HIGH RPM.

   (3) Gear - UP.

   (4) Flaps - UP.

   (5) Airspeed - 208 KIAS (Maximum).

2. Descent - Max Angle (Landing Configuration).

   (1) Power - IDLE.

   (2) Propellers - HIGH RPM.

   (3) Flaps - APPROACH (173 KIAS).

   (4) Gear - DN (154 KIAS).

NOTE

To prevent zeroizing the MODE 4 function of the AN/APX-72 transponder, when the landing gear is down and either transponder or aircraft power is to be turned off, place the CODE switch momentarily in HOLD position.

   (5) Flaps - DOWN (127 KIAS).

   (6) Airspeed - 127 KIAS.

8-26. Descent Arrival Check.

Perform the following checks prior to traffic pattern entry:

1. Seat belts and shoulder harnesses - Secure (passengers checked).

2. Fuel panel - Check.

3. Parking brake handle - In.

4. Engine ice vanes - As required.

8-27. Before Landing.

1. Autofeather - ARM.

2. Flaps - APPROACH (Below 173 KIAS).

3. Gear - DN (below 154 KIAS). Check lights.

4. Autopilot/yaw damp - Disengaged.

5. Landing lights - As required.

NOTE

If the landing gear is down and locked, the gear position indicator lights on the control pedestal will illuminate green and the internal red light in the handle will be extinguished. The warning will be silent when power is reduced.

8-28. Obstacle Clearance Approach.

Fly a traffic pattern completing the Before Landing Check as previously described. Lower flaps on base leg as required and complete final landing check after turning final. Adjust pitch, power and flaps to maintain the desired approach angle and airspeed so as to arrive at the intended landing point at minimum touchdown speed consistent with existing conditions.

8-29. Landing.

1. Gear - Recheck DOWN (check lights).

2. Propellers - As required (HIGH RPM, if beta or reverse is required).

NOTE

Propeller reverse below 40 knots will increase propeller blade erosion. Exercise caution when reversing on surfaces where loose sand, gravel, or dust are present.

a. Normal Landing. Refer to chapter 7 for landing data. Plan the final approach to arrive at runway threshold at recommended approach speed. As the aircraft touches down, gently lower the nosewheel to the runway and use reversing, brakes, or beta range, as required.

b. Crosswind Landing. Crab or slip into wind to correct for drift during final approach. The crab is changed to a slip for roundout and touchdown. Differential power may be used to aid in aircraft control during approach and landing. Refer to chapter 7 for landing data.

c. Power Approach Precision Landing. Set power, flaps, and trim as required to maintain the desired airspeed and descent angle.

d. Touch and Go Landing. If a touch and go landing is to be performed, allow the nosewheel to touch the runway and perform the following:

1. Flaps - As required.
2. Trim - Set.
3. Power - Max allowable.

8-30. Go-Around.

When a go-around is started before the LANDING check, use power as required to climb to, or maintain, the desired altitude and airspeed. If the go-around is started after the LANDING check has been performed, apply maximum allowable power and simultaneously increase pitch attitude to stop the descent. Retract the landing gear after ensuring the aircraft will not touch the ground. Retract the flaps to APPROACH, adjusting pitch attitude simultaneously to avoid an altitude loss. Accelerate to best rate-of-climb airspeed (V_y), retracting the flaps fully after attaining the V_{ref} speed used for the approach and perform the following:

1. Power - As required.
2. Gear - UP.
3. Flaps - UP.
4. Landing lights - OFF.
5. Climb Power - Set.
6. Yaw Damp - As required.

8-31. After Landing.

CAUTION

Prolonged use of landing lights on the ground may cause heat to the plastic landing light shield due to the lack of cooling airflow.

1. Landing/taxi lights - As required.
2. Propellers - HIGH RPM.
3. Flaps - UP.
4. Autoignition - OFF.
5. Anti-icing/deicing - OFF.
6. Engine ice vanes - As required.
7. Radar/transponder - Standby.

NOTE

To prevent zeroizing the MODE 4 function of the transponder, when the landing gear is down and the struts compressed, place the MODE control momentarily in HOLD position before either transponder or aircraft power is turned off. CODE HOLD condition will only be removed when the struts are extended and the MASTER control is not in OFF position.

(O)8. Voice security - Zeroize.

8-32. Engine Shutdown.

1. Parking brake - Set.
2. Landing/taxi lights - OFF.
3. Heater - OFF.
4. Vent blower - OFF.
5. AVIONICS MASTER switch - OFF.
6. Autofeather switches - OFF.
7. Heat switches (10) - OFF.
8. Inverters - OFF.
9. Propellers - FEATHER.
10. Condition levers - FUEL CUTOFF (ITT 610°C or less).
11. Boost pumps - OFF (below 10% N_1).
12. Transfer pumps - OFF.
13. Crossfeed - CLOSED.
14. Beacon/lighting systems - OFF.
15. Master switch - Down.
16. Oxygen regulator control levers - NORMAL, 100%, OFF.
17. Keylock switch - OFF.

8-33. Before Leaving Aircraft.

1. Wheels - Chocked.

NOTE

Parking brakes are primarily intended for short term usage. Temperature changes or system leakage may cause inadvertent brake release.

2. Parking brake - As required.
3. Flight controls - Locked.

(O)4. Voice security computer - Removed.

(O)5. Transponder computer - Removed.

(O)6. Transponder - Check zeroized.

7. Windows and doors - As required.
8. Walk around inspection - Completed.

NOTE

If strong winds are anticipated while the aircraft is unattended, the propellers shall be secured to prevent their windmilling with zero engine oil pressure.

9. DA Forms 2408-12 and -13 - Completed.

NOTE

In addition to established requirements for reporting any system defects, unusual and excessive operation such as hard landings, etc., the flight crew will also make entries on DA Form 2408-13 to indicate when limits in the Operator's Manual have been exceeded.

10. Aircraft - Secure.

SECTION III. INSTRUMENT FLIGHT

8-34. General.

This aircraft is certified for operation under instrument flight conditions. Flight handling, stability characteristics, and range are the same during instrument flight conditions as when under visual flight conditions. Adequate navigation and communication equipment is installed to provide instrument flight.

NOTE

For proper instrument operation, do not taxi until all gyro warning flags are masked from view.

8-35. Instrument Flight Procedures.

Refer to FM 1-5, FM 1-30, FLIP, AR-95-1, FAR Part 91, and procedures described in this manual.

a. Instrument Takeoff. Complete the checks prescribed in this chapter. Align the aircraft with the center of the runway. Allow it to roll straight ahead for a few feet before stopping so the nose wheel will be straight. Hold the brakes and note the heading to be maintained during takeoff roll. Follow takeoff procedures dictated by local conditions.

NOTE

A slight amount of pitch error in the indication of the attitude indicator will result from accelerations or decelerations. It will appear as a slight climb indication after deceleration. The error will be most noticeable at the time the aircraft breaks ground during takeoff.

b. Instrument Climb. Instrument climbs should normally be performed at 140 KIAS. Refer to Chapter 7 for information regarding fuel consumption and rate of climb. When safe altitude and climb airspeed are attained, complete the after-takeoff checks as prescribed in this chapter.

NOTE

Climb or cruise at 10 to 15 KIAS above normal speeds when icing conditions exist. Reducing the angle of attack minimizes the accumulation of ice on all surfaces.

c. Instrument Cruise. There are no unusual flight characteristics during cruise in instrument meteorological conditions.

d. Speed Range. Stability and flight characteristics are normal through the full speed range during instrument flight operations. Power settings during instrument flight should be conducted in accordance with the power charts in Chapter 7.

e. Communication and Navigation Equipment. No special technique due to aircraft configuration is required.

f. Instrument Descent. When a descent at slower than cruise speed is desired, slow the aircraft to the desired speed before initiating the descent. Normal descent or radar controlled descent to traffic pattern altitude can be made using cruise airspeed. Normally, descent will be made with the aircraft in a clean configuration, maintaining cruise speed by reducing power as required. The aircraft is completely controllable in a high rate of descent with the landing gear and wing flaps extended. A high rate of descent may be obtained using the drag on the propellers in HIGH RPM.

g. Holding. Recommended holding airspeed is 140 KIAS. Maintain cruise RPM and reduce power as required. For extended holding patterns, consult the appropriate fuel and power chart in chapter 7. For descents in the holding pattern, decrease power and maintain the holding pattern airspeed.

h. Instrument Approaches. Various procedures can be used for instrument approaches. Whether letdowns are made in clean or in landing configuration are at the discretion of the pilot. Turbulence or action to be accomplished when the aircraft reaches lower altitude will govern the type of letdown. When a low ceiling exists, do not extend flaps to full down (100%) until runway is in sight and landing is assured. If it is necessary to make an emergency instrument descent, the rate during the last 1000 feet prior to landing should be adjusted to less than 500 feet per minute.

8-36. Night Flying.

NOTE

Auto-ignition shall be used for night flights above 14,000 feet.

Night flying is very closely related to instrument flying and may often be conducted almost entirely under instrument conditions. Before takeoff, it is imperative to ensure that all lights, instruments, and avionics equipment are functioning properly. Generally, interior lighting should be kept to the minimum amount which will still allow complete visibility of all instruments and gages. Excessive cockpit lighting decreases outside visibility. Avoid using landing lights when in thick haze, smoke, or fog, as reflected light will reduce visibility and may affect depth perception. During ground operations, the aircraft should be taxied slowly. Once rolling, it is difficult to judge actual ground speed and excessive speeds may be developed without realizing it.

SECTION IV. FLIGHT CHARACTERISTICS

8-37. Normal Flight Characteristics.

The flight characteristics of the aircraft are normal throughout its speed range.

8-38. Stalls.

Ample stall warning, in the form of buffeting or mechanical stall warning, is usually given when a stall approaches. This buffet warning will occur at approximately 5 to 10 knots above stall speed with the aircraft in clean configuration. With full wing flaps, the buffet will occur almost simultaneously with the stall. If a forward loading condition exists, Minimum Control Speed may be encountered rather than full stall. If correct stall recovery technique is used, very little altitude will be lost during the stall recovery. The terms "power-on" and "power-off" will be employed during discussion of specific stall situations. For the purpose of this section, the term "power-on" shall mean that both engines and propellers of the aircraft are operating normally and are responsive to pilot control. The term "power-off" shall mean that both engines are operating at idle power.

a. Power-On Stalls.

(1) The power-on stall attitude is very steep. A light buffet precedes stalls, and the first indication of approaching stall is a decrease in control effectiveness, accompanied by a continuous tone from the stall warning horn (refer to Stall Warning System, Chapter 2). The stall itself is characterized by a rolling tendency if the aircraft is allowed to yaw. The proper use of rudder to prevent yaw will also prevent a tendency to roll. A pitching tendency will develop if the aircraft is held in the stall, resulting in the nose dropping sharply, then pitching to above the horizon. This cycle is repeated until recovery is made.

(2) Control is regained very quickly with little altitude loss, providing the nose is not lowered excessively. Begin recovery with forward movement of the control wheel and a gradual return to level flight. In normal power-on stalls, a steep climb attitude is required. Unless the attitude is maintained, the aircraft will generally "buffet" instead of stall. The roll tendency caused by yaw is more pronounced in power-on stalls, as is the pitching tendency; however, both are easily controlled after the

initial entry. The roll can be prevented by proper rudder pressure. Power-on stall characteristics are not greatly affected by landing gear and wing flap position, except that stalling speed is reduced in proportion to the degree of wing flap extension.

b. Power-Off Stalls. The roll tendency is considerably less pronounced in power-off stalls (in either takeoff, landing, or clean configuration), and is more easily prevented or corrected by proper use of rudder and aileron. The nose will generally drop straight through, with some tendency to pitch up again if recovery is not made immediately. With wing flaps down, there is little or no roll tendency and stalling speed is 7 to 8 knots slower than with wing flaps up. Figure 8-4 shows the indication power-off stall speeds with landing gear and wing flaps UP or DOWN.

c. Accelerated Stalls. Accelerated stalls are caused by increasing the aircraft's weight due to centrifugal force in a turn or an abrupt pullout from a dive. The stall speed is increased by the square root of the G factor multiplied by the normal stalling speed. The aircraft gives noticeable stall warning in the form of buffeting when the stall occurs. The stall warning and buffet can be demonstrated in turns by applying excessive back pressure on the control wheel.

8-39. Spins.

CAUTION

Do not pull out of the resulting dive too abruptly as this could cause excessive wing loads and a possible secondary stall.

Intentional spins are not permitted. If a spin is inadvertently entered, use the following recovery procedures accomplishing steps 1 through 3 as near simultaneously as possible.

1. Power levers - IDLE.

2. Apply full rudder, opposite the direction of spin rotation.

3. Push control wheel full forward and neutralize ailerons.

4. Maintain control positions in Steps 1 through 3 until rotation stops; then, neutralize all controls and execute a smooth pullout.

NOTE

Spin tests have not been conducted on this aircraft. The recovery technique is based on the best available information.

8-40. Diving.

Maximum diving airspeed (red line) is 208 KIAS (208 KCAS, V_{mo}). Flight characteristics are conventional throughout a dive maneuver; however, caution should be used if rough air is encountered after maximum allowable dive speed has been reached, since it is difficult to reduce speed configuration. Dive recovery should be very gentle to avoid excessive aircraft stresses.

8-41. Maneuvering Flight.

The maximum speed at which abrupt full control travel can be applied without exceeding the design load factor of the aircraft is 167 KIAS.

8-42. Flight Controls.

The aircraft is stable under all normal flight conditions.

8-43. Level Flight Characteristics.

All flight characteristics are conventional throughout the level flight speed range.

STALL SPEED
POWER OFF

STALL SPEED
U-21A
T74-CP-700

WANTED

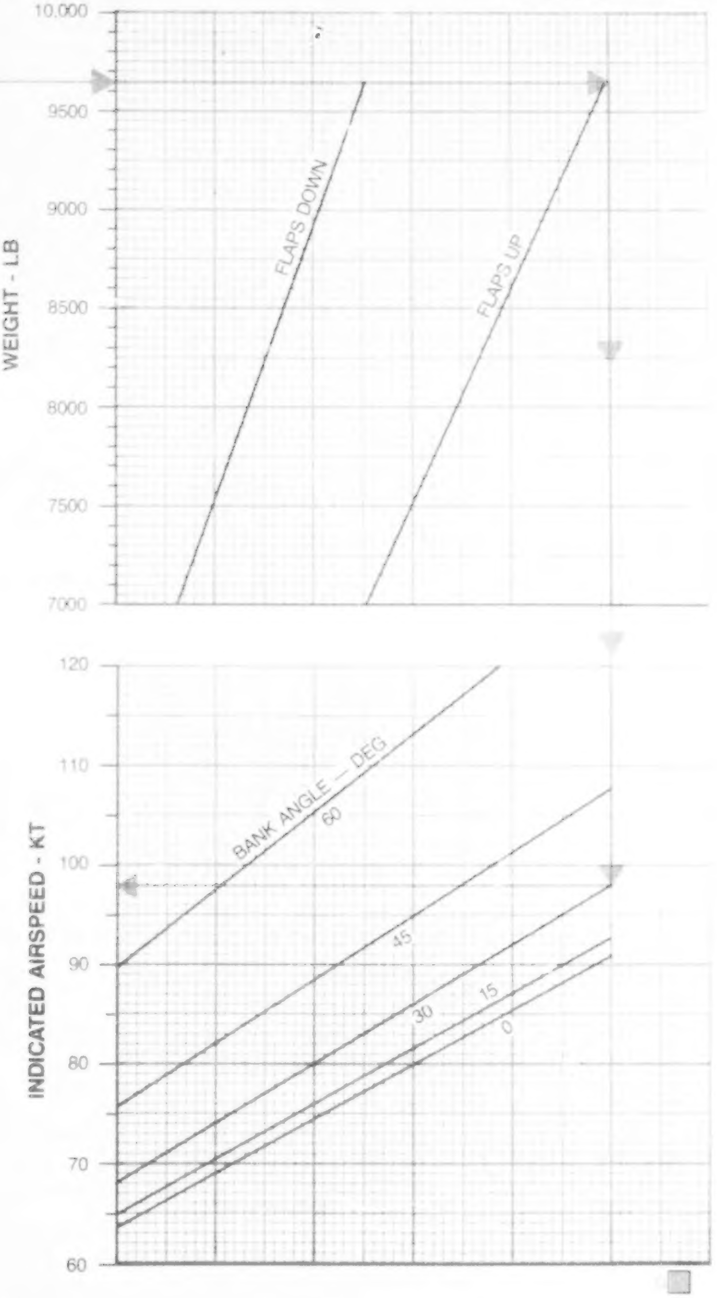
STALL SPEED

KNOWN

WEIGHT = 9650 LB
FLAP SETTING = UP
BANK ANGLE = 30°

METHOD

ENTER WEIGHT HERE
MOVE RIGHT TO FLAP SETTING
MOVE DOWN TO BANK ANGLE, READ
STALL SPEED = 98 KT



DATA BASIS: DERIVED FROM FLIGHT TEST

AP013661

Figure 8-3. Stall Speed

SECTION V. ADVERSE ENVIRONMENTAL CONDITIONS.

8-44. Introduction.

The purpose of this section is to inform the pilot of the special precautions and procedures to be followed during the various weather conditions that may be encountered in flight. This section is primarily narrative; only those checklists that cover specific procedures characteristic of weather operations are included. The checklist in Section II provides for adverse environmental operation.

8-45. Cold-Weather Operation.

Operating difficulties may be encountered during extremely cold weather, unless proper steps are taken prior to or immediately after flight. All official personnel should understand and be fully aware of the necessary procedures and precautions involved.

a. Preparation For Flight. Accumulations of snow, ice or frost on aircraft surfaces will adversely affect takeoff distance, climb performance, and stall speeds to a dangerous degree. Such accumulations must be removed before flight. Refer to Chapter 2, Section XIII. In addition to the normal exterior checks, following the removal of ice, snow, or frost, inspect wing and empennage surfaces to verify that these remain sufficiently cleared. Also, move all control surfaces to confirm freedom of movement. Check tires for proper inflation and assure that they are not frozen to wheel chocks or to the ground. Use ground heaters to free frozen tires. When heat is applied to release tires, the temperature should not exceed 160°F (71°C). In extreme emergencies, tires may be inflated to 1.5 times the normal pressure to break adhesion to ice, then restored to normal pressure. Use external power source for starting engines. Pre-heating of engine oil is unnecessary.

b. Engine Starting. Observe engine starter time limits. If there is no rise in engine oil pressure after 30 seconds or pressure drops below minimum (40 PSI), shut down the engine.

c. Warm-Up And Ground Test. Warm-up procedures and ground test will follow those outlined in Section II.

d. Taxiing Instructions. Avoid taxiing through slush and water if possible. Water and slush splashed on the wings, antennas, and empennage may freeze, increasing weight and drag and possible limit control surface movement.

e. Before Takeoff. Turn on the propeller electrothermal deicer system and all anti-icing systems, just prior to takeoff. Also accomplish the BEFORE TAKEOFF steps in Section II.

f. Takeoff. Takeoff procedures for cold weather operations are the same as for normal takeoff. Follow the procedures in Section II. Deep snow on the runway may cause enough drag to prevent takeoff. Light snow or ice will decrease the traction of the tires. Use of brakes and nose wheel steering may be ineffective.

g. During Flight. It may be advisable to cycle the landing gear a few times after takeoff to dislodge ice accumulated from spray or slush or water on runway. Trim tabs and controls should also be exercised periodically to prevent freezing. If visible moisture is inadvertently encountered, anti-icing systems should be activated.

h. Descent. Use normal procedures in Section II for descent.

NOTE

If icing conditions are encountered during approach, slightly higher-than-normal airspeed should be maintained in order to compensate for the additional increased drag, additional weight, and higher than normal stall speeds.

i. Landing. Use procedures in Section II for normal landing.

NOTE

In order not to impair pilot visibility, reverse thrust should be used with caution when landing on a runway covered with snow or standing water.

j. Engine Shutdown. Follow the normal engine shutdown procedures in Section II.

k. Before Leaving The Aircraft. Park the aircraft in a warm area if possible. Should this be impossible, after wheel chocks are in place, release the brakes to prevent freezing and lock the control surfaces. Condensation will be minimized if aircraft fuel tanks are filled. Remove any accumulation of dirt and ice from the landing gear shock struts. Install protective covers to guard against possible collection of snow and ice.

8-46. Desert Operation.

Dust, sand, and high temperatures encountered during desert operation can sharply reduce the operational life of the aircraft and its equipment. The abrasive qualities of dust and sand upon turbine blades and moving parts of the aircraft and the destructive effect of heat upon the aircraft instruments will increase maintenance, if basic preventive measures are not followed. In flight, the hazards of dust and sand will be difficult to escape, since dust clouds over a desert may be found at altitudes up to 10,000 feet.

a. Preparation For Flight. Check the position of the aircraft in relation to other aircraft. Propeller blown sand blast can damage other aircraft. Wipe the landing gear shock struts free of dust and sand with a clean cloth. Remove all aircraft protective covers. Check instrument panel and general interior for dust and sand accumulation. Open main entrance door and cockpit vent/storm windows to ventilate the aircraft. Operate all moveable control surfaces.

b. Engine Starting. Perform the normal procedures in Section II.

c. Warm-Up Ground Tests. Perform the normal procedures in Section II. To minimize possibility of damage to the engine during desert operation, use inertial separators (activate ICE VANE).

d. Taxiing. When practical avoid taxiing over sandy terrain. Propeller and engine deterioration may result from the impingement of sand and gravel. Use minimum wheel braking action since brake cooling is retarded at high ambient temperatures.

e. Takeoff. No special technique or procedures are required during takeoff.

f. Landing. No special technique or procedures are required during landing. (Refer to Section II for normal engine shutdown procedures.)

g. Before Leaving the Aircraft. Install all protective covers to keep out blowing sand and dust. If blowing sand and dust do not present a hazard, leave the cockpit vent/storm windows open to provide ventilation. Take extreme care to prevent sand or dust from entering the fuel and oil systems during servicing.

8-47. Hot-Weather Operation.

CAUTION

> A limitation based on pressure altitude and ambient temperature prohibits aircraft takeoff under certain high ambient temperature conditions. (Takeoff Temperature Limitation Chart in Chapter 5.)

During hot-weather operations, the principle difficulties encountered are high interstage turbine temperature (ITT) during engine starting and takeoff, over-heating of brakes, and longer takeoff and landing rolls. In areas where high humidity is encountered, electrical equipment (such as communication, fungi, and moisture absorption by nonmetallic materials.

a. Preparation for Flight. No special technique or procedures are required for flight preparation.

b. Engine Starting. Engine starting under conditions of high ambient temperatures may produce a higher than normal ITT during the start. The ITT should be closely monitored when the condition lever is moved to the LO IDLE postion. If overtemperature tendencies are encountered, the condition lever should be moved to IDLE CUTOFF position periodically during acceleration of gas generator RPM (N_1). Be prepared to abort the start before temperature limitations are exceeded.

c. Warm-Up and Ground Tests. Perform normal procedure in Section II.

d. Taxiing. Use the wheel brakes as little as possible since cooling is retarded at high ambient temperatures.

e. Takeoff. No special technique or procedures are required during takeoff.

f. During Flight. No special technique or procedures are required during normal operations.

g. Descent. No special technique or procedures are required during descent.

h. Landing. No special technique or procedures are required during landing.

i. Engine Shutdown. Refer to Section II for ENGINE SHUTDOWN procedure.

CAUTION

> If fuel tanks are completely filled, fuel expansion may cause overflow, thereby creating a fire hazard.

j. Before Leaving the Aircraft. Install wheel chocks and release the wheel brakes to prevent warpage of the brake discs. Leave windows and doors open as necessary for ventilation.

8-48. Turbulent Air and Thunderstorms.

WARNING

Due to the comparatively light wing loading, control in severe turbulence and moderately heavy thunderstorms is critical. Since turbulence imposes heavy loads on the aircraft structure make all necessary changes in aircraft attitude with the minimum amount of control pressures to avoid excessive loads on the aircraft's structure.

Plan the flight to avoid areas of severe turbulence and thunderstorms. During night or instrument flight conditions, it is not always possible to detect individual storm areas or find the in-between clear areas. If such turbulence is to be penetrated, it will be necessary to counter rapid changes in attitude and accept major indicated altitude variations.

8-49. Penetration.

The maximum safe penetration speed in severe turbulence is 168 KIAS. Pitch attitude and constant power settings are vital to proper flight technique. Establish recommended penetration speed and proper attitude prior to entering turbulent air. Maintaining a pre-established attitude will result in a fairly constant airspeed. Complete the following procedures when there is a possibility of encountering turbulent air due to thunderstorm activity:

1. Establish penetration airspeed.

2. Secure loose equipment.

3. No smoking.

4. Tighten seat belts and shoulder harnesses.

5. Turn cockpit and cabin lights on to minimize the blinding effect of lightening.

6. Turn on pitot heat and stall warning heat when visible moisture is encountered.

7. Check flight instruments for proper indication.

8. Advise crew members of approach to storm.

9. Maintain constant power setting and pitch attitude, regardless of airspeed or altitude indications. Concentrate on maintaining a level attitude by reference to the attitude indicator.

NOTE

If possible, adjust to the desired power setting prior to entering a storm area. Generally, this power setting will be lower than that used for cruise operations.

10. Maintain original heading. Make no turns unless absolutely necessary.

11. Do not chase the airspeed indicator; doing so will only result in extreme variations of aircraft attitude and the possibility of exceeding safe airspeed.

12. Apply as little pressure as possible on the control surfaces to prevent excessive strains on the aircraft structure.

13. Erratic altimeter indications may be expected.

8-50. Ice and Rain.

WARNING

Extend the engine ice vanes when temperature is 5°C or below before entering visible moisture. If the ice formation is allowed to progress to a critical point, the loss of intake air may make it impossible for the engine to run at normal power.

WARNING

Auto-ignition shall be used before entering anticipated or actual icing conditions (+10°C or below in visible moisture).

1. If flights into known icing conditions are made, all anti-icing and deicing systems of the aircraft should be properly utilized in accordance with the procedure detailed in Chapter 2. Rain presents no particular problems other than restricted visibility.

2. The aircraft is equipped with anti-icing or deicing to prevent the formation of ice on the pitot tube, stall warning, fuel vents, heater air intake, engine air intake, and propeller blades. Deicer boots are provided to remove ice from the wing and tail leading edges and an electrothermal windshield anti-ice system is provided to prevent ice from forming on the windshield. Windshield defrosters are installed to alleviate conditions resulting from frost or light ice. Windshield wipers are installed for rain

at lower airspeeds. An engine ice vane is provided for removal of ice and rain from the engine intake air. An auto-ignition system automatically provides combustion re-ignition if flameout should occur due to icing conditions, etc. If severe icing conditions are encountered, ascend or descent to altitudes where these conditions do not prevail. Operation of deice and anti-ice equipment discussed here is described in Chapter 2.

(1) Icing. Icing occurs because of supercooled water vapor such as fog, clouds, or rain. The most severe formation will generally occur at approximately -5°C.

(2) Taxiing. Extreme care must be exercised when taxiing on ice or slippery runways. Excessive use of either brakes or power may result in an uncontrollable skid.

(3) Takeoff. Extreme care must be exercised during takeoff from ice or slippery runways. Excessive use of either brakes or power may result in an uncontrollable skid.

(4) Climb. Climb at 10 to 15 KIAS above normal climb speeds when icing conditions exist. Reducing the angle of attack minimizes the accumulation of ice on all surfaces.

(5) Cruising Flight. Prevention of ice formation is more effective and satisfactory than attempts to dislodge the ice after it has formed. If icing conditions are encountered on the anti-icing systems prior to the first sign of ice formation, refer to Chapter 2 for use of deicer boots. Flight in severe icing conditions should not be attempted. If ice forms on the wing area aft of the deicer boots, climb or descent to an altitude where conditions are less severe. An any time visible moisture is present, turn on the pitot and stall warning heat. Refer to Chapter 2 for additional information.

NOTE

Do not operate deicer boots continuously. Continuous operation tends to balloon the ice over the boots. Allow at least 1/2 inch of ice to accumulate on the boots, then activate the deicer boots to remove the ice. Repeat this procedure as required.

(6) Landing. Extreme care must be exercised when landing on ice or slippery runways. Excessive use of either brakes or power may result in an uncontrollable skid.

NOTE

Ice accumulation on the aircraft will result in higher stalling airspeeds, due to the change in aerodynamic characteristics and increased weight of the aircraft due to ice buildup. Approach and landing airspeeds must be increased accordingly.

SECTION VI. CREW DUTIES.

8-51. ★ Crew/Passenger Briefing.

The following guide should be used in accomplishing required passenger briefings. Items that do not pertain to a specific mission may be omitted.

a. Crew Introduction.

b. Equipment.

1. Personnel to include ID tags.
2. Professional
3. Survival.

c. Flight data.

1. Route.
2. Altitude.
3. Time enroute.
4. Weather.

d. Normal procedures.

1. Entry and exit of aircraft.
2. Seating.
3. Seat belts.
4. Movement in aircraft.
5. Internal communications.
6. Security of equipment.
7. Smoking.
8. Oxygen.
9. Refueling.
10. Weapons.
11. Protective masks.
12. Parachutes.

c. Emergency procedures.

1. Emergency exits.
2. Emergency equipment.
3. Emergency landing/ditching procedures.
4. Bail out.

CHAPTER 9

Emergency Procedures

SECTION I AIRCRAFT SYSTEMS

9-1. Aircraft Systems.

This section describes the aircraft systems emergencies that may reasonable be expected to occur and presents the procedures to be followed. Emergency procedures are given in checklist form when applicable. A condensed version of these procedures is contained in the condensed checklist TM 55-1510-215-CL. Emergency operations of avionics equipment are covered when appropriate in chapter 3, Avionics.

9-2. Immediate Action Emergency Checks.

Those checks that must be performed immediately in an emergency procedure are underlined. These immediate action emergency checks must be committed to memory.

NOTE

The urgency of certain emergencies requires immediate and instinctive action by the pilot. The most important single consideration is aircraft control. All procedures are subordinate to this requirement.

9-3. Definition of Landing Terms.

The term LAND IMMEDIATELY is defined as executing a landing a without delay. (The primary consideration is to assure the survival of occupants.) The term LAND AS SOON AS POSSIBLE is defined as executing a landing to the nearest suitable landing area without delay. The term LAND AS SOON AS PRACTICABLE is defined as executing a landing to the nearest suitable airfield.

9-4. Emergency Exits and Equipment.

The main cabin entrance door is used for normal or emergency exit. A removable window (cabin emergency exit hatch) on the right side of the fuselage (fig. 9-1), and the cockpit emergency entrance/exit hatch are used for emergency exit only. The main cabin entrance door, the cabin emergency exit hatch (removable window), and the cockpit emergency entrance/exit hatch provide emergency escape routes from the aircraft either on the ground or when ditching.

9-5. Emergency Entrance.

In the event that entry to the aircraft through the main entrance door is impossible or impractical, entry may be made through the alternate emergency exits which are the cabin window emergency exit hatch (fig. 9-2), or the cockpit emergency entrance/exit hatch. In order to open the cabin window emergency exit hatch, either the right rear window must be broken through or the fuselage cut open along the dotted line stenciled CUT HERE FOR EMERGENCY RESCUE. The cockpit emergency entrance/exit hatch (fig. 9-1) may be removed either externally or from inside the cockpit by actuating either the external or the inside latch handle.

9-6. Engine.

a. Flight Characteristics Under Partial Power Conditions. Single-engine operations, due to an engine malfunction, are sometimes preceded by symptoms which will enable you to take preventative action. Complete engine failure most often occurs due to fuel starvation. This type of emergency situation is seldom due to mechanical causes, however, failure due to carelessness or improper operating techniques is not uncommon. This may be avoided by constant attention to engine torque, turbine temperatures, and fuel and oil pressure and temperatures. These operating limitations are established and discussed in chapter 5. If an engine malfunction is indicated, land as soon as practical. It is essential to have a thorough understanding of the principles affecting single-engine performance and the limitations resulting from the unbalance of power. Two principal factors govern flight safety on one engine: AIRSPEED and POWER; directional control being in proportion to airspeed. There are no unusual flight characteristics during single-engine operation as long as airspeed is maintained at or above minimum control speed (V_{mc}) and stall speed (V_s). Minimum control speed is the minimum airspeed for which lateral and/or directional control can be maintained with the flaps retracted, dead engine propeller feathered, live engine set to takeoff power and 5° maximum bank angle maintained towards the live engine (landing gear UP or DN). The capability of the aircraft to climb or maintain level flight depends on configuration, gross weight, altitude and free air temperature. Performance and control will improve by retracting the landing gear (if extended) and establishing the appropriate single-engine best rate-of-climb speed. Refer to chapter 7 for single-engine climb performance.

b. Engine Malfunction During and After Takeoff. The action to be taken in the event of an engine malfunction during takeoff depends on whether or not takeoff speed has been attained. Refer to Chapter 7 for takeoff performance.

(1) Engine malfunction during takeoff run (abort). Below takeoff airspeed (V_{lof}), use the following procedure:

NOTE

Single-engine reversing may be applied if required. Use extreme caution if takeoff surface is not hard and dry.

1. Power levers - IDLE.
2. Braking - As required.

NOTE

Braking action is impaired if wheels are allowed to skid.

NOTE

If insufficient runway remains for stopping perform steps 3 thru 5.

3. CONDITION levers - FUEL CUTOFF.
4. Firewall Shutoff valves - CLOSED.
5. MASTER SWITCH - DOWN.

(2) Engine Malfunction After Liftoff. If and engine fails after becoming airborne, maintain single-engine best rate-of-climb speed (V_{yse}) or, if airspeed is below (V_{yse}), maintain whatever airspeed is attained between liftoff (V_{lof}) and (V_{yse}) until sufficient altitude is attained to trade altitude for airspeed and accelerate to (V_{yse}).

(3) Engine Malfunction After Liftoff (Abort). Perform the following and land in a wings-level attitude:

1. Power levers - REDUCE.
2. Gear - DOWN.
3. Complete normal landing.

NOTE

If able to land on remaining runway, check gear down, use brakes and reverse thrust as required.

(4) Engine malfunction after takeoff. If an engine malfunctions, after becoming airborne, and best single-engine climb speed has been attained, proceed as follows:

NOTE

Do not retard the malfunctioning engine power lever, or turn the autofeather system OFF, until propeller rotation is completely stopped. To do so will deactivate the autofeather circuit and prevent automatic feathering.

NOTE

If the autofeather system fails to operate, identify the dead engine, retard the power lever of suspected engine to confirm identification, then feather the propeller for the dead engine.

1. Power - Maximum allowable.
2. Gear - UP.
3. Flaps - UP.
4. Engine clean up - Perform.

c. Engine Malfunction During Flight. Refer to chapter 7 for single-engine cruise information. If one engine malfunctions during flight, maintain directional control and proceed as follows:

NOTE

If the situation permits, analyze the malfunction and take appropriate action to restore power.

1. Autopilot/yaw damp - Disengage.
2. Power - As required.
3. Dead engine - Identify.
4. Power lever (dead engine) - IDLE.

CABIN EMERGENCY EXIT HATCH JETTISON PROCEDURE

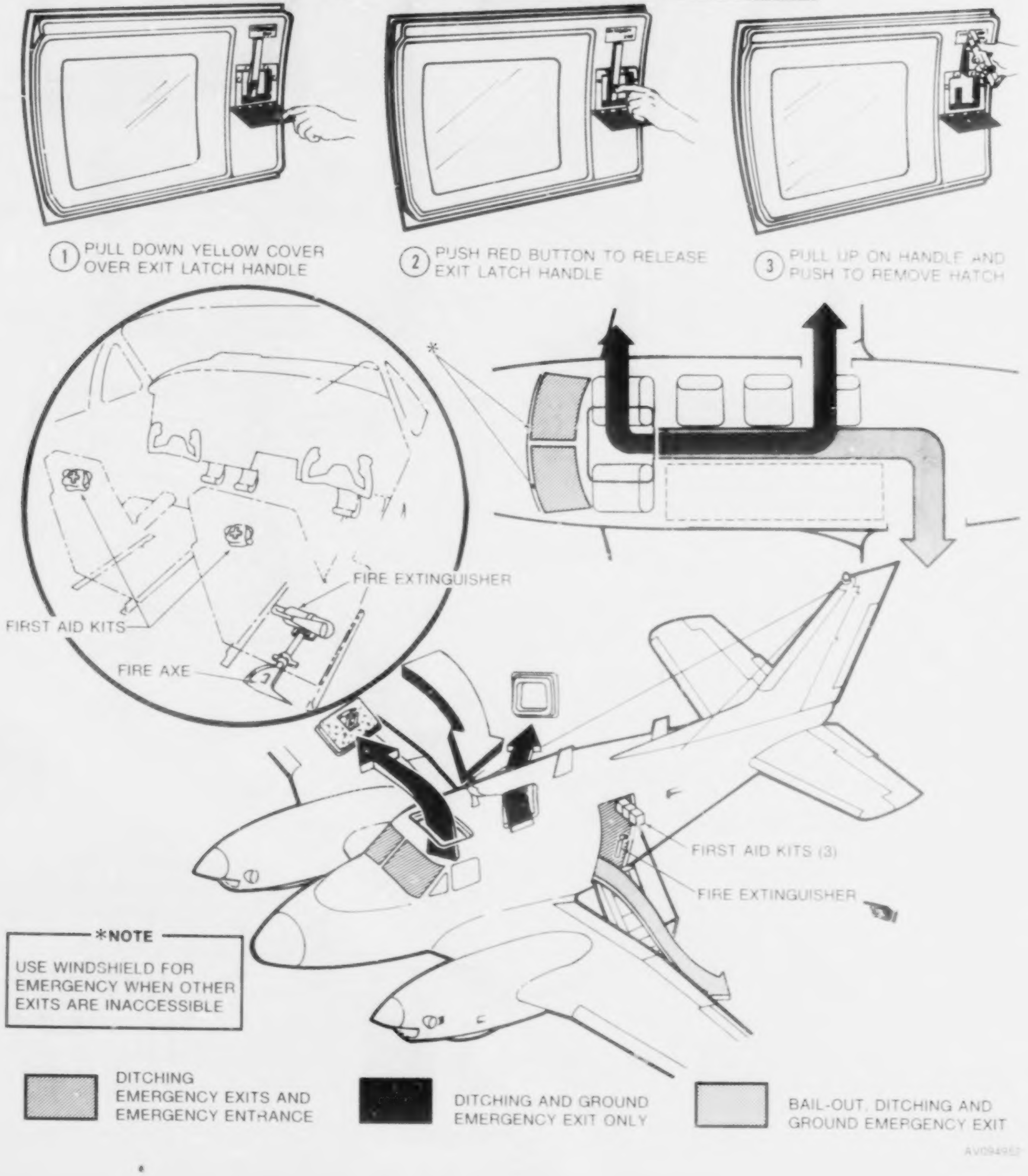
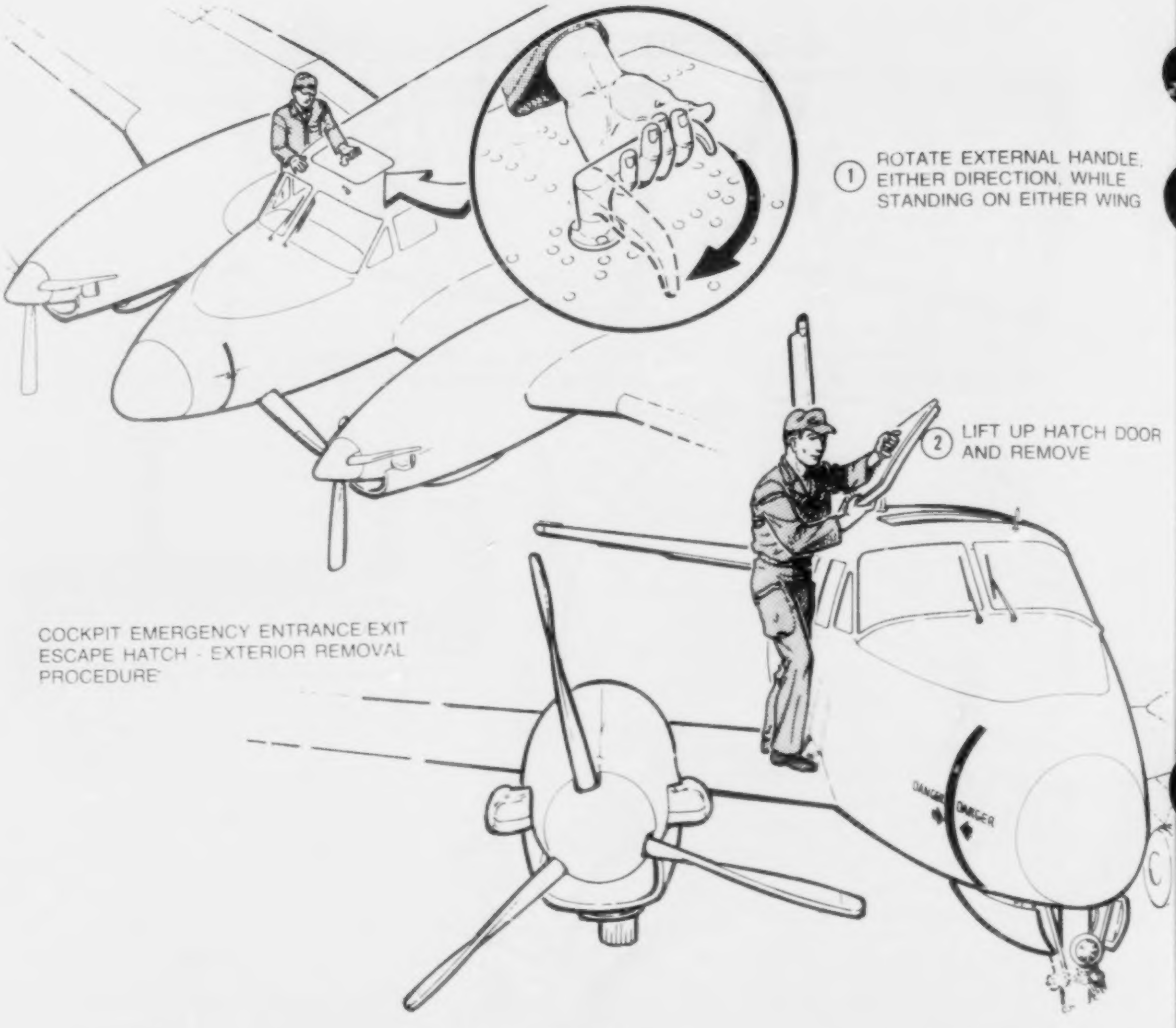

① PULL DOWN YELLOW COVER OVER EXIT LATCH HANDLE
② PUSH RED BUTTON TO RELEASE EXIT LATCH HANDLE
③ PULL UP ON HANDLE AND PUSH TO REMOVE HATCH
*
FIRE EXTINGUISHER
FIRST AID KITS
FIRE AXE
FIRST AID KITS (3)
FIRE EXTINGUISHER
*NOTE
USE WINDSHIELD FOR EMERGENCY WHEN OTHER EXITS ARE INACCESSIBLE
DITCHING EMERGENCY EXITS AND EMERGENCY ENTRANCE
DITCHING AND GROUND EMERGENCY EXIT ONLY
BAIL-OUT, DITCHING AND GROUND EMERGENCY EXIT
AV094952

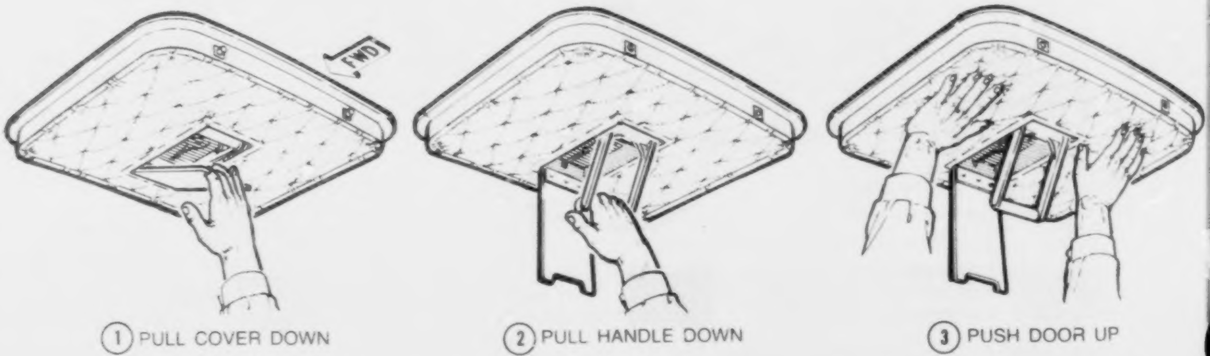
Figure 9-1. Emergency Exits and Equipment (Sheet 1 of 2)



① ROTATE EXTERNAL HANDLE, EITHER DIRECTION, WHILE STANDING ON EITHER WING

② LIFT UP HATCH DOOR AND REMOVE

COCKPIT EMERGENCY ENTRANCE EXIT ESCAPE HATCH - EXTERIOR REMOVAL PROCEDURE



① PULL COVER DOWN

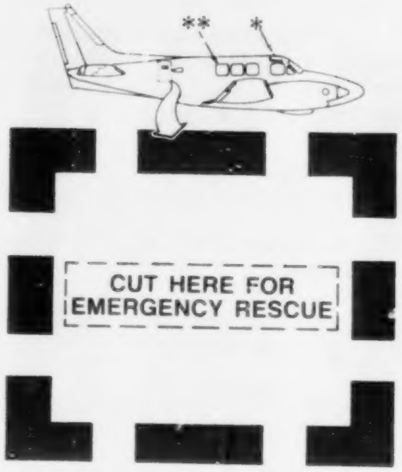
② PULL HANDLE DOWN

③ PUSH DOOR UP

COCKPIT EMERGENCY ENTRANCE/ EXIT HATCH-INTERIOR JETTISON PROCEDURE

AV 094952.2

Figure 9-1. Emergency Exits and Equipment (Sheet 2 of 2)



* TO REMOVE THE COCKPIT EMERGENCY ENTRANCE EXIT HATCH FROM OUTSIDE TURN PROTRUDING EXTERNAL LATCH HANDLE AND LIFT AWAY RELEASED DOOR

NOTE

** EMERGENCY ENTRANCE MAY ALSO BE MADE BY BREAKING IN THE WINDOW ON THE CABIN EMERGENCY EXIT HATCH (FIRST LARGE SQUARE WINDOW SECTION FORWARD OF THE 'CUT HERE FOR EMERGENCY RESCUE' AREA) AND ACTUATING THE HATCH RELEASE MECHANISM.

AV 095259

Figure 9-2. Emergency Entrance

5. Propeller (dead engine) - FEATHER.

6. Condition lever (dead engine) - FUEL CUTOFF.

7. Gear - UP.

8. Flaps - UP.

9. Power - Set (for single-engine cruise).

10. Engine clean up - Perform.

d. Engine Clean Up. Clean up procedure to be used after engine malfunction or an unsuccessful restart is as follows.

1. Boost pump (dead engine) - OFF.

2. Crossfeed - CLOSED (if no restart is to be attempted).

3. Firewall shutoff valve (dead engine) - CLOSED (if no restart is to be attempted).

4. Generator (dead engine) - OFF.

5. Electrical load - Monitor.

(O)6. Autoignition (dead engine) - OFF.

7. Fuel control heat (dead engine) - OFF, (if no restart is to be attempted).

e. Engine Malfunction During Final Approach. If an engine malfunctions during final approach (after LANDING CHECK), continue approach using the following procedure:

1. Power - As required.

2. Gear - DN.

NOTE

100% flaps must be used to obtain the minimum landing distance in chapter 7.

f. Engine Restart During Flight (Using Starter). Successful restarts may be achieved at all altitudes normally flown. Do not attempt to restart the engine unless it can be determined that no damage to the engine will result and no additional hazard will be created. If in doubt, continue single-engine flight and land the aircraft as soon as practicable.

CAUTION

Do not exceed starter limitation of 40 seconds on, and 60 seconds OFF for two starter operations, then 40 seconds on, 30 minutes OFF.

NOTE

The avionics master switch and radar should not normally be turned on, until the generators are on. This will help protect the solid-state circuitry.

1. Electrical load - Reduce to minimum.
2. Firewall shutoff valve - OPEN.
3. Power lever (dead engine) - IDLE.
4. Propeller (dead engine) - FEATHER.
5. Condition lever (dead engine) - FUEL CUTOFF.
6. Boost pumps (2) - ON.
7. Crossfeed - AUTO.
8. Fuel control heat - ON.
9. Ignition/start switch - ON. (Check IGN ON light illuminated, N_1 over 13% and stabilized for approximately 5 seconds).
10. ITT (live engine) - Monitor (750°C maximum).

CAUTION

If ignition is not evident in 10 seconds after moving the condition lever to LO IDLE, position the condition lever to FUEL CUTOFF and the IGNITION/START switch to STOP. Accomplish ENGINE CLEARING procedure (chapter 8). If another restart attempt is to be made, repeat the entire ENGINE RESTART procedure.

11. Condition lever - LO IDLE.
12. ITT and N_1 - Monitor (1090°C maximum).

NOTE

When N_1 is below 13%, starting temperatures tend to be higher than normal. To preclude overtemperature (1090°C or above) during engine acceleration to idle speed, momentarily move the condition lever into FUEL CUTOFF position as necessary.

13. Ignition/start switch - STOP (when N_1 is above 50%, or start attempt is discontinued).
14. Engine clean up - Perform (if restart is unsuccessful).
15. Oil pressure - Check (40 PSI minimum).
16. Generator - ON.
17. Propeller - Synchronize.
18. Power - As required (after engine is stabilized at idle).
19. Electrical equipment - As required.
20. Crossfeed - As required.

g. *Engine Restart During Flight (No Starter Assist, Engine and Propeller Windmilling).* A restart without actuating the starter may be accomplished. The reason for engine malfunction should be determined before attempting a restart. If altitude permits, diving the aircraft will increase engine RPM and assist in restart.

NOTE

The avionics master switch and radar should not normally be turned on, until the generators are on. This will help protect the solid-state circuitry.

1. Electrical load - Reduce to minimum.
2. Firewall shutoff valve - OPEN.
3. Power lever (dead engine) - IDLE.
4. Propeller (dead engine) - HIGH RPM.
5. Condition lever (dead engine - FUEL CUTOFF.
6. Boost pumps (2) - ON.
7. Crossfeed - AUTO.
8. Generator (dead engine) - OFF.
9. Fuel control heat - ON.
10. Airspeed - 140 KIAS (minimum).

11. Altitude - Below 20,000 feet.

12. Autoignition - ARM.

CAUTION

If ignition is not evident in 10 seconds after moving the condition lever to LO IDLE, position the condition lever to FUEL CUTOFF and the autoignition switch, if installed, to OFF. If another restart attempt is to be made, repeat the entire ENGINE RESTART procedure.

13. Condition lever - LO IDLE.

NOTE

When N_1 is below 13%, starting temperatures tend to be higher than normal. To preclude overtemperature (1090°C or above) during engine acceleration to idle speed, momentarily move the condition lever into FUEL CUTOFF position as necessary.

14. ITT and N_1 - Monitor (1090°C maximum).

15. Engine clean up - Perform if restart is unsuccessful.

16. Oil pressure - Check (40 PSI minimum).

17. Generator - ON (when N_1 is above 50%).

18. Propeller - Synchronize.

19. Power - As required.

20. Autoignition - As required.

21. Electrical equipment - As required.

22. Crossfeed - As required.

h. Maximum Glide. In the event of failure of both engines, maximum gliding distance can be obtained by feathering both propellers to reduce propeller drag and by maintaining appropriate airspeed per the Maximum Glide Distance Chart (fig. 9-3), with the gear and flaps up. Turn off all electrical equipment to conserve battery power for extending the gear and flaps, but leave the master switch ON. Refer to the Maximum Glide Distance Chart (fig. 9-3).

i. Landing With One Or More Engines Inoperative.

NOTE

With one engine inoperative level flight cannot be assured with full flaps and the landing gear down.

(1) Single-engine landing. Fly a normal pattern and perform Single Engine Before Landing check as appropriate. Extend flaps beyond the approach position only if required, and then only after there is no possibility of a go-around. Plan for a slightly higher than normal approach, allowing for sufficient straight-away on final, so minor alignment, speed, and altitude corrections can be accomplished without excessive low altitude maneuvering. Do not extend full-flaps until gear is down and locked. Make a normal touchdown, reducing power during flareout. Avoid excessive or abrupt changes in power. A feathered propeller will result in less drag and may cause the aircraft to "float" during landing. After touchdown, apply brakes and propeller reversing as required.

NOTE

Single-engine reversing may be applied if required. Use extreme caution if landing surface is not hard and dry.

(2) Forced landing - no power. If sufficient landing area, a circular pattern will provide best observation of surface conditions, wind speed and direction. When the condition of the terrain has been noted and the landing area selected, set up a rectangular pattern and extend the gear when landing is assured. Fly the base leg as necessary to control point of touchdown. With both propellers feathered, the normal tendency is to overshoot due to less drag. In the event a positive gear down and locked indication cannot be determined, prepare for a gear up landing. Refer to LANDING EMERGENCIES (para. 9-13).

(3) Single-engine descent-arrival check. Perform the following checks prior to traffic pattern entry:

1. Seat belts and shoulder harnesses - Secure (crew/passengers checked).

2. Fuel panel - Check.

3. Parking brake handle - In.

4. Engine ice vanes - As required.

MAXIMUM GLIDE DISTANCE

GLIDE DISTANCE
U-21A
T74-CP-700

ASSOCIATED CONDITIONS:

1. POWER OFF (PROPELLERS FEATHERED)
2. GEAR AND FLAPS UP
3. ZERO WIND
4. AIRSPEED AND WEIGHT COMBINATIONS SHOWN PRODUCE MAXIMUM GLIDE DISTANCE

WEIGHT — LBS.	BEST GLIDE SPEED KIAS
9650	112
9000	108
8000	102
7000	94
6000	87

EXAMPLE

WANTED

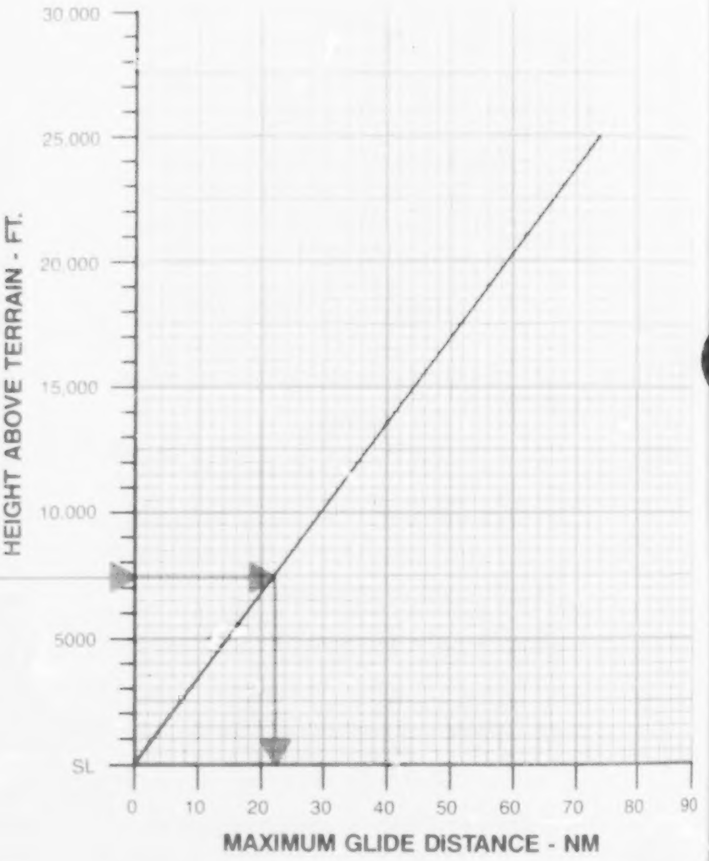
MAXIMUM GLIDE DISTANCE

KNOWN

HEIGHT ABOVE TERRAIN = 7400 FT

METHOD

ENTER HEIGHT ABOVE TERRAIN HERE
MOVE RIGHT TO MAXIMUM GLIDE DISTANCE LINE
MOVE DOWN, READ MAXIMUM GLIDE DISTANCE = 22 NM



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AP 001544

DATA BASIS: ESTIMATED

Figure 9-3. Maximum Glide Distance

(4) Single-engine before landing check. Perform the following checks upon pattern entry:

1. Flaps - APPROACH (below 173 KIAS).

NOTE

To prevent zeroizing the Mode 4 function of the transponder, when the landing gear is down (struts compressed) and either transponder or aircraft power is to be turned off, place the CODE switch momentarily in HOLD position.

2. Gear - DN (below 154 KIAS). Check lights.

3. Landing lights - ON.

(5) Single-engine landing check.

NOTE

100% flaps must be used to obtain the minimum landing distances in chapter 7.

1. Gear - Recheck DN (check lights).

2. Propeller (live engine) - HIGH RPM.

WARNING

Once the flaps are full DOWN on a single-engine landing, do not attempt a go-around.

j. Single-Engine Go-Around. The decision to go around must be made as early as possible, in any event, before the LANDING CHECK. Maintain the proper approach speed. Refer to chapter 7 for recommended approach speed for aircraft weight and for best single engine rate-of-climb speed. Perform single-engine go-around as follows:

NOTE

Elevator control forces at the start of a go-around are very high; retrim as time permits. Also, a considerable amount of rudder control will be required at low airspeeds and if insufficient or applied too slowly, directional control cannot be maintained.

1. Power - Set maximum allowable.

2. Gear - UP.

3. Flaps - UP.

4. Power - As required.

5. Landing/taxi lights - As required.

k. Chip Detector Warning Light On. The illumination of either chip detector light on the annunciator panel will require the following immediate procedures:

1. Engine instruments - Monitor.

2. Land as soon as practical.

9-7. Propeller.

a. Propeller Failure. If an overspeed condition occurs that cannot be controlled with the propeller lever, or by reducing power, feather the propeller. If the propeller feathers by itself complete the feathering procedure. The engine with the disabled propeller may be operated to provide electrical power for systems needed in flight. The procedure to follow in the event of propeller failure is as follows:

1. Power (failed prop) - IDLE.

2. Propeller (failed prop) - FEATHER.

3. CONDITION lever - As required.

4. Engine cleanup - As required.

b. Secondary Low Pitch Stop Light On. The procedure to follow in the event of illumination of a SECONDARY LOW PITCH STOP light is as follows:

1. Propeller RPM and engine torque - Monitor.

2. The action to be taken depends on torque and propeller speed:

WARNING

Propeller RPM increase and torque decrease when a light illuminates indicates a malfunction in the primary governor system and/or the hydraulic low pitch stop. The overspeed governor will prevent RPM from exceeding 2288. Do not pull the PROP GOV IDLE STOP circuit breaker, as this could cause propeller reversal. Secure engine as soon as practical.

(1) If propeller RPM increases and engine torque decreases - Secure engine as soon as practical.

WARNING

While operating with the PROP GOV IDLE STOP circuit breaker pulled, the secondary low pitch stop system is inoperative. Should the primary hydraulic low pitch stop fail, the propeller will reverse when power is reduced.

(2) If propeller RPM decreases and engine torque increases - Pull PROP GOV IDLE STOP circuit breaker immediately (on right subpanel).

NOTE

Propeller RPM decreases and torque increase indicates malfunction of the secondary low pitch stop system which will cause the propeller to feather within 10 to 60 seconds. In this event, PULL the PROP GOV IDLE STOP circuit breaker and continue flight to destination. Malfunction of the secondary low pitch stop must be corrected before further flight.

(3) If propeller RPM and torque remain stable, reset the PROP GOV IDLE STOP circuit breaker.

9-8. Fire.

a. Engine Fire. The following procedures indicate the action to be taken in case of engine fire.

NOTE

No engine fire extinguisher systems are installed.

(1) Engine/nacelle fire during start or ground operation. If a nacelle fire should develop during start or ground operations, proceed as follows:

1. Firewall shutoff valves - CLOSED.
2. Master switch - Down.
3. Propellers - FEATHER.

(2) Engine fire - during flight. In the event an engine fire develops during flight, shut down the affected engine in the following manner:

1. Firewall shutoff valve - CLOSED.
2. Power - IDLE.
3. Propeller - FEATHER.
4. Condition lever - FUEL CUT-OFF.
5. Boost pump - OFF.
6. Transfer pump - OFF.
7. Crossfeed - CLOSED.

b. Fuselage Fire. If a fuselage fire occurs, perform the following:

WARNING

The extinguisher agent (Bromochlorodifluoromethane) in the fire extinguisher can produce toxic effects if inhaled.

1. Fight the fire.
2. Land immediately if fire continues.

c. Wing Fire. There is little that can be done to control a wing fire except to shut off fuel and electrical systems that may be contributing to the fire, or which could aggravate it. Slipping the aircraft away from the burning wing may help.

WARNING

Land the aircraft immediately, or bail out, depending on circumstances and seriousness of the fire.

d. Electrical Fire. All circuits are protected by circuit breakers, which tends to prevent an electrical fire. Up[illegible]ing the existence of an electrical fire, immediately turn off all affected electrical circuits, if known.

If electrical fire source is unknown, proceed as follows:

(O)1. Crew oxygen masks - As required.

(O)2. Passenger oxygen masks - As required.

3. Master switch - Down.

4. All electrical switches - OFF.

5. Battery - ON

6. Generators - ON

7. Essential equipment - ON (individually until fire source is isolated).

NOTE

With battery switch and generator switches turned OFF, landing gear, wing flaps, and auxiliary and transfer pump circuits will be inoperative. If deemed reasonably safe, turn on battery or generator switch long enough to extend the landing gear and then turn it off again. Otherwise extend the landing gear manually and land with the wing flaps up.

e. Smoke and Fume Elimination. To eliminate smoke and fumes from the aircraft, perform the following:

1. Crew oxygen masks - On.

2. Passenger masks - ON. The copilot should confirm that all passengers are receiving supplemental oxygen.

3. Cockpit vent/storm windows - Open as required.

9-9. Fuel System.

a. Fuel System Emergencies. The engine will operate with an engine driven fuel boost pump failure. However, failure of an engine-driven (high pressure) fuel pump will result in engine fuel starvation. Perform the SINGLE-ENGINE procedure and land as soon as practical.

CAUTION

Do not use fuel firewall valve to shut down engine operation, except in an emergency. The engine-driven high-pressure fuel pump obtains essential lubrication from fuel flow. When an engine is operating, this pump may be severely damaged (while cavitating) if the firewall valve is closed before the condition lever is moved to the FUEL CUT-OFF position.

b. Fuel Leaks/Syphoning. The action to be taken in the event of fuel leaks or syphoning depends upon the origin and severity of fuel loss. If fuel filler cap syphoning occurs proceed as follows:

1. Airspeed - 120 KIAS.

2. Land as soon as practicable.

c. Fuel System Crossfeed Single-Engine Operation. During single-engine operation the fuel supply for the dead engine may be used to supply the live engine by routing the fuel through the crossfeed system. Use the following procedure for fuel crossfeed during single-engine operation:

1. Firewall shutoff valve (dead engine) - CLOSED.

2. Boost pump (dead engine) - ON.

3. Crossfeed - OPEN.

4. Fuel crossfeed light - Check illuminated.

NOTE

With a firewall shutoff valve closed, the respective BOOST FAIL light may be illuminated, but the indication will lack significance due to the closed position of the firewall valve.

5. Transfer pump (dead engine) - ON.

6. Boost pump (live engine) - Check OFF (side receiving crossfeed).

7. Fuel pressure (live engine) - Verify.

8. Crossfeed and fuel quantity - Monitor.

d. Fuel Transfer - Manual. A no fuel transfer condition is indicated by illumination of a red LH NO FUEL TRANSFER or RH NO FUEL TRANSFER light on the annunciator panel, and the simultaneous flashing of the FAULT WARN LIGHT. Manual refill of a nacelle tank is conducted with the TRANSFER PUMP switch ON, and is initiated by holding the respective TRANSFER TEST switch in the selected position (L or R). The switch may or may not be released after fuel transfer has started. If the TRANSFER TEST switch is released, fuel transfer will be stopped by either 24 or 57-gallon float switch. If the TRANSFER TEST switch is held ON, the transfer pump will continue to run (overriding the float switches) until all available fuel is transferred. The pump will then automatically shut off and the appropriate NO FUEL TRANSFER light will illuminate on the annunciator panel, indicating that no more fuel is available for transfer. However, if transferrable fuel remains in the wing tanks after the nacelle tank is filled to capacity, continuing to hold the TRANSFER TEST switch ON will only circulate fuel between the nacelle tank and the wing tanks.

NOTE

With fuel remaining in the wing tanks, illumination of the NO FUEL TRANSFER light, after manual activation of the TRANSFER TEST switch, indicates transfer pump failure.

e. Operation After Boost Pump Failure.

CAUTION

Engine operation using only the engine-driven fuel pump without boost fuel pressure is limited to 10 cumulative hours. All time in this category shall be entered on DA Form 2408-13 for the attention of maintenance personnel.

WARNING

During operation after boost pump failure, the CROSSFEED switch must be placed in the CLOSED position to prevent using fuel from the boosted side only. This would result in aircraft imbalance and eventual fuel starvation of the engine with the operating boost pump.

Should a situation arise where a boost pump fails and the crossfeed switch is in the AUTO position, automatic crossfeed will start. With a boost pump not operating, the engine can continue to operate (sometimes at reduced power) from it's own fuel supply on engine-driven pump pressure only. To do this, place the crossfeed switch in the CLOSED position. The engine will then continue to operate from it's own fuel supply. After landing both fuel boost pumps shall be operable before next flight.

9-10. Electrical System.

WARNING

If battery overheats, do not open battery compartment or attempt to disconnect or remove battery. Battery fluid will cause burns, and overheated battery could cause thermal burns and may explode.

CAUTION

Circuit breakers should not be reset more than once until the cause of circuit malfunction has been determined and corrected.

a. Electrical Power System Failure. In the event both generators and the battery are shut off, the flaps will be inoperative, and the landing gear must be extended manually. All systems (except the stall warning horn) which utilize DC power for operation (including the AC power system) will be inoperative.

CAUTION

Only one attempt should be made to restore an inoperative generator to use.

b. Generator Failure. Either generator is capable of carrying the full load of normal aircraft electrical equipment. If one generator becomes inoperative, all non-essential electrical equipment should be used judiciously to avoid overloading the remaining generator. Loads in excess of single generator output will drain the battery, with the resultant loss of reverse and emergency power. The choice of equipment to be used will be determined by existing conditions. The use of accessories which create a very high drain, should be avoided. If both generators are shutoff due either to generator failure, ground fault, or engine failure, all equipment should be turned off to preserve battery power for extending the landing gear and wing flaps. The general location of failure within the aircraft electrical system may be indicated by illumination of the respective GEN OUT annunciator panel red light, and the simultaneous flashing of the FAULT WARN light. Illumination indicates one of three conditions, generator failure, generator overvoltage, or a faulted generator feeder cable. If the indicated generator cannot be returned to the line, reduce load on the remaining generator to a volt-loadmeter reading of 1.0 or less for continuous operation.

c. One Generator Out Light With Flashing Fault Warn Light. Indications will be: all aircraft systems working, corresponding volt-loadmeter shows no load, no circuit breakers are tripped. (Probable cause: an open reverse current diode, a faulty generator control unit, or a bad generator ground.) The following procedure will be used:

1. Inoperative generator switch - OFF, then ON.

2. Inoperative generator switch (GEN OUT) light remains illuminated) - OFF.

3. Electrical equipment - OFF, as required to reduce operating generator load to 1.0 or less.

NOTE

In no case, will a single fault which causes a generator to be shut off cause the loss of more than one power source.

d. Divergent Volt-Loadmeter Readings. Indications will be: All aircraft systems are working, and both generators are operating. There should be no cause for alarm. Generator load-sharing (paralleling) is lost, however all systems should continue to operate with the loads receiving power from one generator or the other. (Probable cause: a faulty generator paralleling control circuit or an open bus generator limiter). There is no procedure by which the pilot may restore generator paralleling during flight.

e. Both Gen Out Lights Illuminated.

1. Generators - OFF, then ON.

2. Generators (GEN OUT lights remain illuminated) - OFF.

3. All nonessential electrical equipment - OFF.

4. Land as soon as practicable.

f. Inverter Failure. Either inverter is capable of supplying the full amount of normally required single-phase AC power. The failure of an inverter will be indicated by illumination of AC warning lights (RADIO AC OUT, GYRO AC OUT, or ENG AC INST OUT).

g. AC OUT Lights Illuminated.

1. Inverter - Select other inverter.

2. Inverter control circuit breakers - Reset.

NOTE

Allow at least a 30 second cooling period before resetting inverter control circuit breaker.

3. AC OUT lights remain illuminated - Return to original inverter.

4. AC OUT lights still remain illuminated - Inverter off.

5. TACAN - OFF.

6. Land as soon as practicable.

h. Feeder Bus Failure. Equipment receiving power from a failed feeder bus should not be returned to service. The electrical load can be reduced by turning OFF all non-essential electrical equipment.

i. Battery Monitor Light Illuminated. Illumination of the battery monitor light indicates excessive charge of battery. This is a normal function after a battery start or after lowering gear and flaps. However, illumination during normal steadystate cruise flight indicates that conditions exist that may cause a battery thermal runaway. Proceed as follows:

1. Battery switch - OFF.

2. Loadmeter - Check.

NOTE

A DECREASE reading of 0.25 or more graduation (approx. one needle width) verifies a deteriorating battery. Leave battery switch OFF for remainder of flight.

3. Battery condition good - Battery switch ON.

4. Battery condition unsatisfactory - Battery ON for flap and landing gear extension only.

5. Battery - OFF.

9-11. Door Open Light Illuminated.

1. Do not attempt to close door.

2. Land as soon as practible.

9-12. Split Flap Condition.

A split flap condition exists when the flaps are in an asymmetic configuration. Initial indication of a split flap condition is a rolling motion during flap extension or retraction. Procedure for recovery is as follows:

1. Aileron/Rudder - As required.

2. Power - Asymmetric power as required to maintain aircraft control.

3. Flaps - extend/retract to symmetric configuration, if possible.

9-13. Emergency Descent.

Emergency descent is a maximum effort in which damage to the aircraft must be considered secondary to getting the aircraft down. For emergency descent, proceed as follows:

CAUTION

Do not practice EMERGENCY DESCENT procedure. Damage to landing gear door will result.

1. Power - IDLE.
2. Propellers - HIGH RPM.
3. Gear - DN.
4. Flaps - APPROACH
5. Airspeed - 154 KIAS Maximum.

9-14. Landing Emergencies.

WARNING

The heater must be shut down prior to all emergency landings to minimize fire hazards.

a. Landing Gear System Failure. Should one or more of the landing gear fail to extend, or fail to indicate a safe condition, the following steps should be taken before proceeding manually to extend the gear.

1. Gear control circuit breaker - Check.

2. Gear indicator circuit breaker - Check.

CAUTION

If the LANDING GEAR POWER circuit breaker is tripped, allow approximately three minutes cooling time before resetting.

3. Gear power circuit breaker - Check.

4. Gear indicators - Check

5. Gear handle - UP, then DN.

6. Gear position - Check (use air-to-air or air-to-ground fly-by method for visual landing gear position verification).

b. Landing Gear Emergency Extension. The landing gear may be extended manually if the electrical portion of the extension mechanism should fail. As airspeed is reduced, it is correspondingly easier to manually actuate the emergency extension handle. When making an emergency gear extension, proceed as follows:

1. Airspeed - Below 154 KIAS.

2. Gear power circuit breaker - Out (pulled).

3. Gear handle - DN.

4. Gear emergency clutch disengage lever - Pull up and turn clockwise.

CAUTION

Do not pump handle after GEAR DOWN position indicator lights (3) are illuminated. Further movement of the handle could damage the drive mechanism.

5. Gear emergency extension handle - Pump the handle up and down until the three GEAR DOWN green lights illuminate. In the event of complete electrical failure, pump until resistance is felt.

NOTE

The landing gear cannot be retracted manually.

c. Gear-Up Landing. The main landing gear wheels protrude slightly from the wheel well in the gear-up position and will roll when the aircraft is landed with the gear retracted. Due to decreased drag with the gear up, the tendency will be to overshoot the approach. It is recommended that the landing be made with full flaps on a hard surface runway, preferably paved. In landing on soft ground or dirt, sod has a tendency to roll up into chunks damaging the underside of the aircraft's structure. When making a gear-up landing, proceed as follows:

1. Crew/passenger emergency briefing - Complete.
2. Loose equipment - Stow.
3. Seat belts and harnesses - Secure.
4. Gear emergency clutch disengage lever - Disengage.
5. Gear emergency extension handle - Stow.
6. Gear control, circuit breaker - In.
7. Gear handle - UP.
8. Flaps - As required.
9. Non-essential electrical equipment - OFF.
10. Condition levers - FUEL CUTOFF (on ground when able).
11. Master switch - DOWN.

d. Landing With Main Gear Down, Nose Gear Up or Unlocked. If a landing gear indicator shows an unsafe indication every possible means should be used to determine the position of the landing gear.

If a landing is to be made with the nose gear up or unlocked and the main gear down, then it is recommended that the landing be made on a prepared runway. After touchdown, hold the nose off as long as possible allowing the nose to smoothly touch down with minimum speed.

A full flap landing is recommended. After touchdown, flaps should be retracted. Adjusting to full nose down elevator trim at this point will aerodynamically increase up elevator control effectiveness, thus, allowing a much lower nose touchdown speed.

Use the following procedure as applicable:

1. Crew/passenger emergency briefing - Complete.
2. Loose equipment - Stow.
3. Seat belts and harnesses - Secured.
4. Non-essential electrical equipment - OFF.
5. Condition levers - FUEL CUTOFF (on ground when able).
6. Master switch - DOWN.

e. Landing With One Main Gear Up or Unlocked. If one main landing gear fails to extend and the opposite gear extends normally, a break in the drive mechanism to the unextended gear has occurred. If all efforts to retract the extended gear fail, land the aircraft on a runway or on firm, hard surface in preference to loose dirt or grass. Touchdown smoothly, well over to the same side of the runway as the extended gear to allow room for loss of directional control. Holding the opposite wing high and nose straight, lightly apply brake to the unsafe gear. This jar may result in locking the unsafe gear. If not, allow the opposite wing to lower slowly. Evacuate the aircraft as soon as possible. Use the following procedures as applicable:

1. Crew/passenger emergency briefing - Complete.
2. Loose equipment - Stow.
3. Seat belts and harnesses - Secured.
4. Non-essential electrical equipment - OFF.
5. Condition levers - FUEL CUTOFF (on ground when able).
6. Master switch - DOWN.

f. Landing With Nose Gear Down, Main Gear Up or Unlocked. Complete the same approach and procedures as used for GEAR-UP LANDING.

g. Landing With Flat Tire. When landing is made with a flat tire on one main gear, the aircraft may turn toward the flat tire side. Directional control can be maintained with wheel braking and reverse thrust. If aware that a main gear tire is flat, a landing close to the edge of the runway opposite the flat tire will help avoid veering off the runway. If the nose wheel tire is flat, nose wheel stability will be reduced and application of brakes should be used only as required to maintain positive control. Use the following procedures:

1. Land on the side of runway favoring good tire.

2. Brake - On good wheel only.

3. Flat nose tire - Use light braking.

9-15. Ditching.

a. General. The following ditching procedures are based on the experiences of pilots who have successfully ditched other multi-engine aircraft. The success of those ditchings were the result of all crewmembers carrying out the correct ditching procedures. Ditching commenced from low altitudes does not always allow time for more than minimum preparation and planning and may not permit relying on the checklist. Therefore it is essential that each crewmember be thoroughly familiar with ditching procedures and assigned responsibilities. Further, the pilot in command must insure that all passengers have been briefed on ditching procedures and understand how to use installed survival equipment. If at all possible ditching should be made while power is still available on both engines. However, if one engine has failed, the ditching should be accomplished in as near symmetrical condition as possible. An engine and/or wing fire is probably the most serious condition from the standpoint of structural integrity and lateral control. A fire concentrated within the wing or nacelle will be sustained by fuel or oil and will destroy effective use of flaps and ailerons in a very short time. With such a fire, except in extremely high wind conditions the aircraft should be ditched parallel to the primary swell system. Model test and actual ditchings of various aircraft indicate that ditchings into the wall of water created by the major swell is roughly analogous to flying into a mountain. Accordingly a careful evaluation of sea condition is essential to successful ditching. While descending, begin analyzing the sea condition as soon as the surface can be seen clearly (2000 feet or more if possible). The primary swell can readily be distinguished from high altitude and will be seen first. At low altitude it may be hidden beneath another system plus a surface chop, but from altitude the largest and most dangerous system will be the first one recognized. The wind driven sea, if any will be recognized by the appearance of white caps.

b. Ditching Under IMC Conditions. Where IMC conditions or night operations preclude visual determination of sea conditions, forecast data should be utilized, and the ditching must be made on instruments. With no surface reference, the aircraft must be flown into the water on heading, and in a fixed attitude which combines safe control speed and rate of descent. Whenever possible, ditching should be made as close as safety permits to coastlines or in the vicinity of surface vessels to improve the rescue situation. If radios are still operational, attempt to contact costal stations or surface vessels for current wind, sea swell, and altimeter setting.

SURFACE CONDITION	WIND SPEED KNOTS
Few white crests	10-15
Many white crests	15-25
Streaks of foam from crests	25-35
Spray blown from tops of waves	35-45

NOTE

Ditch parallel to and near the crest of the swell unless there is a strong crosswind of 20 knots or more. In strong winds ditch heading should be more into the wind and slightly across the swell, planning to touchdown on the upslope of the swell near the top (fig. 9-6). Wave motion is indicative of wind direction, but the swell does not necessarily move with the wind. Water surface conditions are indicative of windspeed, as related below:

NOTE

Full flaps are recommended for power on ditching. However, impaired directional control caused by engine loss or aileron damage is another factor to be considered in determining ditching configuration. At low gross weights, it is possible to retain an optimum ditching airspeed, desired rate of descent, and directional control by using full flaps and power as necessary on the operating engine. If direction control problems are anticipated and available power is insufficient to maintain desired rate of descent, consideration should be given to utilization of approach flaps. It is difficult to judge height above a calm sea, and use of landing lights at night make the estimate even more difficult.

WARNING

Do not remove raft from its carrying case inside the aircraft.

CAUTION

Keep life raft away from any damaged surfaces which might tear it.

WARNING

Do not unstrap from the seat until all motion stops. The possibility of injury and disorientation requires that evacuation not be attempted until the aircraft comes to a complete stop.

c. Ditching Procedure.

(1) Ditching procedure with power:

1. Announce intention to ditch and time to impact.
2. Distress message - Transmit
3. Transponder - Emergency.
4. Life vest - Put on and adjust (do not inflate).
5. Seat belts/harnesses - Secure (passengers in braced position).
6. Gear - UP.
7. Flaps - Down.

NOTE

Rate of descent, 100 ft. per min. during final stages of the approach (approximately last 300 feet).

8. Airspeed - 100 KIAS.

(2) Ditching Procedure Without Power:

1. Announce intention to ditch and time to impact.
2. Distress message - Transmit
3. Transponder - Emergency.
4. Life vest - Put on and adjust (do not inflate).
5. Seat belts/harnesses - Secure (passengers in braced position).
6. Gear - UP.
7. Flaps - APPROACH.
8. Airspeed - 100 KIAS.

d. Water Entry. It is essential that an attempt be made to control the attitude of the aircraft throughout ditching until all motion stops. Evacuate the aircraft through the emergency exit or main entrance door. Take the life raft and first aid kit.

e. After Leaving Aircraft. When safely clear of the aircraft, pull inflation ring to inflate the raft. Tie down first aid kit in the center of the raft to prevent it from being lost in case the raft capsizes. After all personnel have been evacuated move raft out from under any part of the aircraft which might strike them as it sinks. Remain in the vicinity of the aircraft as long as it remains afloat.

9-16. Bailout.

When the decision has been made to abandon the aircraft in flight, the pilot will give the warning signal. Exit from the aircraft will be through the main entrance door, and in the departure sequence using the exit routes as indicated in the Emergency Exits and Equipment illustration (fig. 9-1). Proceed as follows if bailout becomes necessary:

1. Radio - Distress procedure (If time permits).
2. Voice security and transponder - ZEROIZE.
2. Airspeed - Reduce.
3. Flaps - DOWN.
4. Trim - As required.
5. Main entrance door - OPEN.
6. Abandon the aircraft.

APPENDIX

A

REFERENCES

Reference information for the subject material contained in this manual can be found in the following publications.

AR 70-50	Designating and Naming Defense Equipment, Rockets,and Guided Missiles
AR 95-1	Army Aiation - General Provisions and Flight Regulations
AR 95-16	Weight and Balance - Army Aircraft
AR 380-40	Safeguarding COMSEC Information
AR 385-40	Accident Reporting and Records
AR 700-26	Aircraft Designation System
FAR Part 91	General Operating and Flight Rules
FM 1-5	Instrument Flying and Navigation for Army Aviators
FM 1-30	Meteorology for Army Aviators
TB 55-1500-314-25	Handling, Storage, and Disposal of Army Aircraft Components Containing Radioactive Materials
TB AVN 23-13	Anti-icing, Deicing, and Defrosting Procedures for Parked Aircraft
TB MED 501	Noise and Conservation of Hearing
TB 55-9150-200-24	Engine and Transmission Oils, Fuels and Additives for Army Aircraft
TM 11-6140-203-14-2	Operator's Organizational, Direct Support, General Support and Depot Maintenance Manual Including Repair Parts and Special Tools List: Aircraft Nickel-Cadmium Batteries
TM 38-750	Army Maintenance Management System
TM 55-405-9	Army Aviation Maintenance Manual: Weight and Balance
TM 55-410	Aircraft Maintenance, Servicing and Ground Handling Under Extreme Environmental Conditions
TM 55-1510-200-PM	Phased Maintenance Checklist
TM 55-1500-204-25/1	General Aircraft Maintenance Manual
TM 55-1510-209-23	Aviation Unit and Aviation Intermediate Maintenance Manual, Army Models U-21A, RU-21A, and RU-21D
TM 750-244-1-5	Procedures for the Destruction of Aircraft and Associated Equipment to Prevent Enemy Use

APPENDIX B

ABBREVIATIONS AND TERMS

For the purpose of this manual, the following abbreviations and terms apply. See appropriate technical manuals for additional terms and abbreviations.

B-1. Airspeed Terminology.

CAS	Calibrated airspeed is indicated airspeed corrected for position and instrument error.
FT/MIN	Feet per minute.
GS	Ground speed, though not an airspeed, is directly calculable from true airspeed if the true wind speed and direction are known.
IAS	Indicated airspeed is the speed as shown on the airspeed indicator and assumes no error.
KT	Knots.
TAS	True airspeed is calibrated airspeed corrected for temperature, pressure, and compressability effects.
V_a	Maneuvering speed is the maximum speed at which application of full available aerodynamic control will not overstress the aircraft.
V_f	Design flap speed is the highest speed permissible at which wing flaps may be actuated.
V_{fe}	Maximum flap extended speed is the highest speed permissible with wing flaps in a prescribed extended position.
V_{le}	Maximum landing gear extended speed is the maximum speed at which an aircraft can be safely flown with the landing gear extended.
V_{lo}	Maximum landing gear operating speed is the maximum speed at which the landing gear can be safely extended or retracted.
V_{lof}	Lift off speed (takeoff airspeed).
V_{mca}	The minimum flight speed at which the aircraft is directionally controllable as determined in accordance with Federal Aviation Regulations. Aircraft Certification conditions include one engine becoming inoperative and windmilling; a 5° bank towards the operative engine; takeoff power on operative engine; landing gear up; flaps up; and most rearward CG. This speed has been demonstrated to provide satisfactory control above power off stall speed (which varies with weight, configuration, and flight attitude).
V_{mo}	Maximum operating limit speed.
V_{ne}	Never exceed speed.
V_r	Rotation speed.
V_s	Power off stalling speed or the minimum steady flight speed at which the aircraft is controllable.
V_{so}	Stalling speed or the minimum steady flight speed in the landing configuration.
V_{sse}	The safe one-engine inoperative speed selected to provide a reasonable margin against the occurence of an unintentional stall when making intentional engine cuts.

V_x	Best angle of climb speed.
V_{xse}	Best single-engine angle of climb speed.
V_y	Best rate of climb speed.
V_{yse}	The best single engine rate of climb speed.

B-2. Meteorological Terminology.

Altimeter Setting	Barometric pressure corrected to sea level.
°C	Degrees Celsius.
°F	Degrees Fahrenheit.
OAT	Outside air temperature is the outside air static temperature, obtained either from ground meteorological sources or from inflight temperature indications adjusted for compressibility effects. The number actually read from an altimeter when, the barometric scale (Kollsman window) has been set to 29.92 inches of mercury (1013 millibars).
ISA	International Standard Atmosphere in which: a. The air is a dry perfect gas; b. The temperature at sea level is 59 degrees Fahrenheit, 15 degrees Celsius; c. The pressure at sea level is 29.92 inches Hg; d. The temperature gradient from sea level to the altitude at which the temperature is -69.7 degrees Fahrenheit is -0.003566 Fahrenheit per foot and zero above that altitude.
Pressure Altitude (press alt)	Indicated pressure altitude corrected for altimeter error.
SL	Sea level.
Wind.	The The wind velocities recorded as variables on the charts of this manual are to be understood as the headwind or tailwind components of the actual winds at 50 feet above runway surface (tower winds).

B-3. Power Terminology.

Beta Range	The region of the power lever control which is aft of the idle stop and forward of reversing range where blade pitch angle can be changed without a change of gas generator RPM.
Cruise Climb	Is the maximum power approved for normal climb. This power is torque or temperature (ITT) limited.
High Idle	Obtained by placing the condition lever in the HIGH IDLE position.
HP	Horsepower.
Low Idle	Obtained by placing the condition lever in the LO IDLE position.
Maximum Cruise Power	Is the highest power rating for cruise and is not time limited.
Maximum Power	The maximum power available from an engine for use during an emergency operation.
Normal Rated Climb Power	The maximum power available from an engine for continuous normal climb operations.

Normal Rated Power	The maximum power available from an engine for continuous operation in cruise (with lower ITT limit than normal rated climb power).
Reverse Thrust	Obtained by lifting the power levers and moving them aft of the beta range.
RPM	Revolutions Per Minute.
Takeoff Power	The maximum power available from an engine for takeoff, limited to periods of five minutes duration.

B-4. Control and Instrument Terminology.

Condition Lever (Fuel Shut-Off Lever)	The fuel shut-off lever actuates a valve in the fuel control unit which controls the flow of fuel at the fuel control outlet and regulates the idle range from LO to HIGH.
Interstage Turbine Temperature (ITT)	Thermocouple probes wired in parallel indicate the temperature between the compressor and power turbines.
N_1 Tachometer (Gas Generator RPM)	The tachometer registers the RPM of the gas generator with 100% representing a gas generator speed of 37,500 RPM.
Power Lever (Gas Generator N_1 RPM)	This lever serves to modulate engine power from full reverse thrust to takeoff. The position for idle represents the lowest recommended level of power for flight operation.
Propeller Control Lever (N_2 RPM)	This lever requests the control to maintain RPM at a selected value and, in the maximum decrease RPM position, feathers the propeller.
Propeller Governor	This Governor will maintain the selected propeller speed requested by the propeller control lever.
Torquemeter	The torquemeter system determines the shaft output torque. Torque values are obtained by tapping into two outlets on the reduction gear case and recording the differential pressure from the outlets.

B-5. Graph and Tabular Terminology.

AGL	Above ground levelBest
Best Angle of Climb	The best angle-of-climb speed is the airspeed which delivers the greatest gain of altitude in the shortest possible horizontal distance with gear and flaps up.
Best Rate of Climb	The best rate-of-climb speed is the airspeed which delivers the greatest gain of altitude in the shortest possible time with gear and flaps up.
Clean Configuration	Gear and flaps up regardless of mission antenna installation.
Demonstrated Crosswind	The maximum 90° crosswind component for which adequte control of the aircraft during takeoff and landing was actually demonstrated during certification tests.
Gradient	The ratio of the change in height to the horizontal distance, usually expressed in percent.
Landing Weight	The weight of the aircraft at landing touchdown.
Maximum Zero Fuel Weight	Any weight above the value given must be loaded as fuel.
MEA	Minimum Enroute Altitude.
Obstacle Clearance Climb Speed	Obstacle clearance climb speed is a speed near V_x and V_y, 1.1 times power off stall speed or 1.2 times minimum single-engine stall-speed, whichever is higher.
Ramp Weight	The gross weight of the aircraft before engine start. Included is the takeoff weight plus a fuel allowance for start, taxi, run up and takeoff grond roll to liftoff.

Route Segment	A part of a route. Each end of that part is identified by: a. A geographic location; or b A point at which a definite radio fix can be established.
Service Ceiling	The altitude at which the minimum rate of climb of 100 feet per minute can be attained for existing aircraft weight.
Takeoff Weight	The weight of the aircraft at liftoff from the runway.

B-6. Weight and Balance Terminology.

Arm	The distance from the center of gravity of an object to a line about which moments are to be computed.
Approved Loading Envelope	Those combinations of aircraft weight and center of gravity which define the limits beyond which loading is not approved.
Basic Empty Weight	The aircraft weight with unusable fuel, full oil, and full operating fluids.
Center-of-Gravity	A point at which the weight of an object may be considered concentrated for weight and balance purposes.
CG Limits	CG limits are the extremes of movement which the CG can have without making the aircraft unsafe to fly. The CG of the loaded aircraft must be within these limits at takeoff, in the air, and on landing.
Datum	A vertical plane perpendicular to the aircraft longitudinal axis from which fore and aft (usually aft) measurements are made for weight and balance purposes.
Engine Oil	That portion of the engine oil which can be drained from the engine.
Empty Weight	The aircraft weight with fixed ballast, unusable fuel, engine oil, engine coolant, hydraulic fluid, and in other respects as required by applicable regulatory standards.
Landing Weight	The weight of the aircraft at landing touchdown.
Maximum Weight	The largest weight allowed by design, structural, performance or other limitations.
Moment	A measure of the rotational tendency of a weight, about a specified line, mathematically equal to the product of the weight and the arm.
Standard	Weights corresponding to the aircraft as offered with seating and interior, avionics, accessories, fixed ballast and other equipment specified by the manufacturer as composing a standard aircraft.
Station	The ongitudinal distance from some point to the zero datum or zero fuselage station.
Takeoff Weight	The weight of the aircraft at liftoff.
Unusable Fuel	The fuel remaining after consumption of usable fuel.
Usable Fuel	That portion of the total fuel which is available for consumption as determined in accordance with applicable regulatory standards.
Useful Load	The difference between the aircraft ramp weight and basic empty weight.

B-7. Miscellaneous Abbreviations.

Deg	Degrees
DN	Down
FT	Foot or feet
FT LB	Foot-pounds RL1 GALGallons

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C